ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLIV. No. 8. NEW YORK, SATURDAY, FEBRUARY 20, 1904. ISSUED WEEKLY

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PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: 40 Dearborn Street. Chicago, Ill. . CHARLES FFRENCH, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

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CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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THE WAVE-LENGTH OF N-RAYS.

Although the German and English physicists have not been able to identify the N-rays, Blondlot and the French physicists are devoting much time to their study, and almost daily are giving out new results. One of the important announcements made recently by Blondlot is that he has succeeded in determining the wave-length of these rays. Various methods were used, but all gave concordant results, and indicated that the wave-length of these rays is exceedingly small, being of the order of 100,000 waves to the millimetre. This would place the rays considerably beyond the ultra-violet, a field which has heretofore remained unexplored. This discovery, if it can be verified, is exceedingly important, and it is to be regretted that others have not succeeded in finding the N-rays, although their discoverer says that they are easy to detect.

EDISON.

Thursday, February 11, was the fifty-seventh anniversary of the birth of that veteran inventor, Thomas Alva Edison, to whom belongs the distinction of having developed and installed the first commercial incandescent lighting system. To have accomplished this would, in itself, be deemed sufficient honor by most men; but while this may be considered as one of the greatest, if not the greatest of Edison's works, it embraces only a small part of the wide field of invention and development in which he has labored. He began life as a newsboy, with nothing but his own efforts and ability to depend upon. It is a far cry from this to the position of the most distinguished and prolific of American inventors—a position which none will deny him. His career began when there was but one branch of applied electricity—the telegraph, and in this field his inventions were of the utmost importance. Here, again, to have perfected the quadruplex system would be reckoned by many to have constituted a notable life work; but so varied have been Edison's attainments in other fields that it is probable that his name is seldom associated in the public mind with telegraph improvement.

The career of Edison is inseparable from the development and expansion of the electric arts during the past thirty years of their wonderful growth, for there is scarcely a branch of applied electricity which one can take up without finding, and being assisted by, Edison's earlier work; in the telegraph, telephone, electric light, electric traction, primary and secondary batteries, wireless telegraphy, everywhere has he labored and with good results. Such versatility would be almost unbelievable were we not familiar with it; yet this untiring genius has done notable work in fields not electrical. One need only mention his cement process, the phonograph, the kinetoscope, to show his diversity. In nearly every direction in which he turns his inventive powers, important results are accomplished.

To those who do not know better it may seem that much of what has been done by Mr. Edison was done by inspiration; that he instinctively knew what was needed and at once produced the completed device. This is far from the truth. Few, if any, important inventions have been made in this way. Hard study and tiresome work must precede great and revolutionizing inventions, and in this Edison is unsurpassed. The inspiration of what is desirable comes to those who feel the coming needs before they are recognized by the public; but the means of satisfying these, or even perhaps of hastening the demand, can only be supplied by those who know and understand the facts relating to the subject in mind. These grasped, then the true genius of the inventor is shown in devising ways and means of overcoming difficulties in improving and perfecting the system or device which is to become an important factor in our advancing civil-

ization. In the early part of the last century the stage-coach was quite satisfactory to the traveler. In 1840 communication by slow mail answered all needs of the times. The telephone and the electric light were not necessary in 1870, nor the electric car in 1880. Yet the far-seeing minds of those immortals whose names are indelibly written in the history of civilization and shine with increasing brilliancy as the years go by, believed that the times were ripe for better methods, and believed also that they knew better ways. They were right, but in all cases they had to contend with a sceptical world, as well as the disappointments and discouragements met in their own work. Such has been the experience of all great inventors, and he who would be successful must bear through all a cheerful disposition and a stout heart. How well Mr. Edison has met these requirements, all who have met him know. He is never dismayed. Failures mean simply that so much ground has been covered, and he is just that much nearer to his goal.

Edison's career has truly been wonderful, and his business ability has aided materially in securing a reward for his genius. What his final position may be in the world of invention it is yet too early to predict, as he is still at work and expects to accomplish much more; but it was highly proper that the American Institute of Electrical Engineers, representing the great body of electrical workers of this country, should honor one who has done so much to advance the art.

DRIVE FACTORIES ELECTRICALLY AND AVOID FLOODS.

Years ago, when waterfalls were the chief source of power for operating mills, it was usually essential to build the mill close to the stream, and frequently in a narrow gorge or valley. Under these conditions interruptions and losses due to floods were to be expected, and could hardly be avoided. As the steam engine became of greater importance for factory driving, one might have expected to see greater freedom used in the selection of factory sites. This has been true to some extent, but while it is not necessary to place the steam plant in a gorge, it is usually desirable to locate it near water; and as low-lying ground is cheap, as a general rule, the tendency to place factories where they are subject to floods still exists.

Flooded Shops Avoided by Motor Drive.

This ought not to be true to-day. For many other good reasons the use of electric motors in factory driving is becoming general, but it seems worth while to emphasize the fact that the use of motors makes it possible to place the factory at a point where it will not be affected by floods. The ease of power transmission by electricity gives a greater freedom in the selection of sites, and while it is desirable to have a good supply of water at the power station, and is therefore desirable that the latter be near a stream, it may be amply protected against high water, and the factory building put well out of danger. Under the worst conditions the power station might be flooded, but this need not involve much loss; while at the factory there could be no trouble except a possible stoppage due to lack of power. It may be out of the question to move an old establishment, though the cost of securing immunity from floods would be money well spent. But no new factory need nor should be located in an exposed position.

Other Advantages of Higher Factory Sites.

The factory will gain in another way. At present, where the works are on low ground, the residences of many of the employés are also placed in exposed locations, where good sanitary conditions are hard to obtain. This point should be borne in mind when selecting a site, and it would doubtless be possible in almost every case to select one which is not only healthy and entirely removed from danger of floods, but which is close enough to water to make the question of transmission easy and simple. A power-house half a mile away would be just as convenient as one 200 yards away, as the engineer could probably be reached more quickly by telephone than by messenger.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTRO-METALLURGY.

In the series of notes on the progress in industrial electrochemistry and electrometallurgy, by Mr. John B. C. Kershaw, now appearing in the ELECTRICAL REVIEW, the author has covered practically the entire field and brought the information up to date. Progress in these applications is taking place so rapidly that it is only by means of such summaries that one is enabled to keep in touch with the work that is going on. In a number of instances, what may eventually prove to be important inventions are pointed out, and the bearings of such upon the present state of the art are indicated. One of these which deserves mention is the new German process for the fixation of nitrogen. This was described in the note appearing February 13. A mixture of iron and charcoal, heated to 2,000 degrees centigrade in an electric furnace, is brought into contact with nitrogen or air. Chemical combination takes place, resulting in the compound named cyanamide, which may become important as an artificial fertilizer. The importance of perfecting some method of making available for plant food the inexhaustible supply of nitrogen in the air has been discussed fully within the last three years. Our present supplies are rapidly becoming exhausted, and as yet there is no process in commercial operation. The new process suggested makes use of cheap materials, so that its value will probably depend largely upon the efficiency of furnace operation.

Another somewhat similar process has been patented in this country. In this, however, titanium oxide is used instead of lime, a nitride of titanium being formed in the furnace. While as yet it is impossible to say whether either of these processes will prove satisfactory in actual practice, there seems to be little doubt that the work started as the result of an address made by Sir William Crookes many years ago will result in the development of some satisfactory process before our present supplies are exhausted.

THE INCANDESCENT LAMP.

The year 1904 marks the twenty-fifth anniversary of the commercial introduction of the incandescent lamp, a fact which was commemorated by the annual dinner of the American Institute of Electrical Engineers, at which Mr. Thomas A. Edison was the guest of honor. It may be interesting at this time to review briefly a few of the important phases in the development of what is now generally conceded to be the most important system of artificial illumination ever devised.

The first indications of the possibility of the incandescent lamp are due to Sir Humphrey Davy, who not only discovered the electric arc, but, by means of the electric current, raised conducting bodies to incandescence. Davy made use of rods of carbon formed from vegetable fibre, and brought them to incandescence both in the air and in a vacuum. The possibility of employing this means of producing artificial illumination was evident, but at that day the only source of electric current was the primary battery; and to use this as a commercial source of energy was impractical. In order that the new illuminant might be made practically useful, much work was yet to be done. Electromagnetic induction was yet to be discovered, and a practical dynamo to be evolved after years of research and experiment, and it was not until half a century had passed, and the work of Faraday and others had been completed, that the possibility of obtaining an electric current from a machine driven by mechanical power cleared the way for the completion of the work begun by Davy and for the invention of a practical incandescent lamp.

It had been recognized by those who were working on this lamp that the action of the oxygen of the air upon the incandescent conductor must be prevented, and the simplest way of securing this condition was to enclose the glowing body in a glass bulb, from which oxygen might be excluded. Many materials were tried in this way, but it was found practically impossible to prevent air from leaking in at the points where the conducting wires passed through the glass. It was necessary that the enclosing globe be sealed perfectly at all points, and although the globe might be filled with an inert gas, this would not prevent oxygen from diffusing in and destroying the filament if the sealing were defective at any point. On the other hand, it was found that better results were obtained when the globe was exhausted than when filled with an inert gas. Lamps filled with inert gas may show good results for a short time, but their lives would be short, and they would therefore be uncommercial.

A turning point in construction was reached when Dr. Isaac Adams, of Gloucester, Mass., evolved a glass whose coefficient of expansion was identical with that of platinum, thus making air-tight sealing-in and a higher vacuum possible. Although Adams's work was of the greatest importance, the practical lamp was still far from being invented. In general, those working on this problem thought that the lamps should be connected in series, and that, therefore, they should have a low resistance; but Lane-Fox, in 1878, sought to make a high-resistance lamp, though he did not succeed in constructing an effective mechanism.

At this point the work of Edison begins. To start with he had the principle of a body brought to incandescence in an exhausted glass globe, and the exceedingly crude dynamos of that day. From his work has resulted the incandescent lamp, practically as we know it to-day, the system of distribution at a constant potential, and the method of supplying the lamps from a central generating station. He not only brought the lamp to a practical commercial stage, but he devised a practical method of operating these lamps and actually put his system into service.

To decide upon the most suitable material for the filament, practically every conducting substance was tried. Carbon promised best, but there was a long, weary search in order to discover the fibre most suitable for this use. Edison finally selected carbonized bamboo. Others have succeeded in making suitable filaments by carbonizing cotton threads, and to-day filaments are made from pure cellulose dissolved in a suitable solution, and then, when viscous, forced under pressure through dies. These threads are hardened in alcohol and then carbonized, the result being a more uniform thread of carbon than could possibly be obtained by baking any vegetable fibre. This process has resulted from the work of many inventors who have devoted years of patient research to perfecting the filament.

The next important advance after securing the cellulose filament was the invention of the so-called flashing treatment. In this treatment the carbonized filament is brought to incandescence in a gasoline vapor, thus causing a thin deposit of dense graphite on the surface and affording a means for adjusting the lamps to the proper voltage and candle-power, the duration of treatment being controlled automatically.

The perfection of the incandescent lamp forms really only a part of the whole, for, in addition to the lamp, the entire system of supply and its means of regulation and control were necessary. All of this was worked out by Mr. Edison, and although his methods might seem crude, in view of the elaborate development which has since taken place, he nevertheless brought out and put into service a lamp and a system which would not only work, but which could be worked commercially. Since the old Pearl street station was put into service early in 1880, the business has expanded rapidly until to-day there is not a town of any importance in this country which has not electric lighting stations and rarely is any other system of illumination considered for any large modern building.

THE ELECTROCHEMICAL EQUIVALENT OF SILVER.

Various careful attempts to determinate the electrochemical equivalent of silver give values varying from 0.011156, as determined by Mascart, to 0.011195, that found by Pellat and Leduc. It is probable that the electrical congress, which will be held at St. Louis, Mo., next September, will consider the matter of taking steps toward having this value redetermined. In the meantime, a determination made by G. Van Dijk and J. Kunst gives as a mean value of twenty-four measurements, 0.0111818, a value which the authors believe to be accurate within one part in 10,000.

Pratt Street Power-House at Baltimore Not Destroyed by the Fire.

One of the remarkable features of the great Baltimore fire was the saving of the Pratt street power-house of the United Railways and Electric Company with all of its valuable electrical machinery, although the building was in the midst of the conflagration. The saving of the house and its contents was a piece of great good luck for the whole city as well as for the company that owned it, as it permitted of the starting up of the street railway service within twenty-four hours after the fire was under control and a resumption of service which otherwise might have been delayed for weeks.

The story of the saving of the power-house is told as follows in a letter from Mr. W. F. Fowler, the Baltimore sales manager of the Westinghouse Electric and Manufacturing Company:

This power-house consisted of three sections; the first section being the old power-house, in which was installed direct-current apparatus; the second section was the boiler room; the third section was the new plant, in which were installed four 2,000-kilowatt, 13,200-volt, three-phase, flywheel-type alternators. The bus-bar structure is in the basement and over this are installed the oil switches, three for each generator and three for each feeder. The control of these switches is in a gallery built at the end of the generator room.

The old part of the power-house was destroyed, and in the new part where our generators are located the basement was flooded with water nearly up to the bottom high-tension bus-bar. The building in which this machinery was installed, however, is absolutely fireproof, the window casings and frames being of copper and the glass provided with wire netting. While the flames raged all around, the building did not suffer, and in fact a cat which was in this power-house came through alive. The old power-house burned early Monday morning; by Tuesday afternoon at five o'clock the water had been removed from the basement of the new section, test had been made of our apparatus, and the result was that the machines were placed in operation at this hour and started in to furnish current to the substations, and have been running ever since without difficulty.

The Watt Anniversary.

On Saturday, January 23, the James Watt anniversary dinner was held at the Windsor Hotel, Glasgow, Scotland, by the Institution of Engineers and Shipbuilders. More than 300 distinguished engineers and scientists were present.

Philadelphia Branch of the American Institute of Electrical Engineers.

A meeting of the Philadelphia branch of the American Institute of Electrical Engineers was held at the Engineers' Club, of Philadelphia, on the evening of February 8.

Mr. C. E. Bonine gave a talk on the "Principles of Alternating-Current Motors," which was followed by an abstract by Mr. E. P. Coles of Mr. Walter I. Slichter's paper on "Speed-Torque Characteristics of the Single-Phase Repulsion Motor," and Mr. Charles P. Steinmetz's paper on "The Alternating-Current Railway Motor," which were presented at the New York meeting.

Mr. C. E. Renshaw, of the Westinghouse company, Pittsburg, gave a paper on "Alternating-Current Railway Motors." Mr. Renshaw dwelt upon the many advantages the alternating-current motor has over the direct for railway purposes, and went into details as to the principles governing the single-phase alternating-current motor.

The discussion was participated in by Messrs. Cutler, Thomas Spencer and Breed.

Photographic Action of Radium Rays.

At a meeting of the British Physical Society, held on January 22, a paper was read by Mr. S. Skinner, entitled "The Photographic Action of Radium Rays." The following is the official abstract:

It is well known that a photographic plate by exposure to radium rays is affected in such a way that the plate develops similarly to its development after exposure to light. The experiments described in the paper are an attempt to answer the question, "Are the actions the same?" As far as can be seen, the final results of the action and development are the same, and the experiments appear to indicate that only slight differences occur in the early stages. The plates, suitably enclosed, were subjected to the rays from varying quantities of radium bromide for varying times, and the results show that the intensity of the developed image increased rapidly to a maximum value with increase of exposure; then decreased, first rapidly, and finally very slowly, until a stage was reached in which there was practically no dark image formed on development. It is found that spark images are at first obliterated by radium rays which do not cause such a great density as that of the spark images obliterated, and that with prolonged exposure the radium rays reverse the spark images.

American Institute of Electrical Engineers.

The 184th meeting of the American Institute of Electrical Engineers will be held at the Chemists' Club, 108 West Fifty-fifth street, New York, Friday, February 26, at 8.15 P. M. The following papers will be presented and discussed:

"European Practice in the Construction and Operation of High-Tension Transmission Lines and Insulators," by Guido Semenza, chief electrical engineer of the Italian Edison Company of Milan, Italy.

"Conductivity of the Atmosphere at High Voltages," by Harris J. Ryan, professor of electrical engineering Sibley College, Cornell University, Ithaca, N. Y.

Continuous Electrical Service.

President Charles W. Eliot, of Harvard University, made a notable and profound address on labor problems before the Central Labor Union at Faneuil Hall, Boston, on the evening of February 7, at which, among other truths, he recognized the necessity of absolutely constant and continuous electrical service for light, telegraph and telephone, as being necessities of life.

He said:

People can wait for cigars or cash registers, or even for houses and shops; but they can not wait long for food, or domestic fuel, or, in cities, for the water which must be pumped by coal, or for the street lights produced by coal. Already in the United States the supplies of these necessaries of life in modern society have been seriously threatened, and indeed, for brief periods, partly cut off.

From such dangers society must find a sure way to defend itself. The total interruption of the post office, telegraph or telephone service, or municipal water supplies is not to be contemplated by modern society. Other modes than strikes or lockouts must be used for adjusting wages and hours of labor in such services as these.

Report of the Commissioner of Education.

The report of the commissioner of education of the Department of the Interior, for the year 1902, has been issued. This contains reports and discussions of education in Porto Rico and Alaska, with statistics of educational institutions in this country.

The Yorkshire Electric Power Company's Generating Station.

In the issue of the ELECTRICAL REVIEW for January 9 a descriptive article was published under the above heading. Through an error in printing it was neglected to give credit to the *Electrician*, London, for this article.

ELECTRIC POWER FOR RAILWAYS.[1]

BY B. S. LANPHEAR.

In the first part of this paper is given a brief review of some of the pioneer work in electric railroading, showing the development of electrical apparatus as measured by the increase in confidence manifested by railway engineers and capitalists. In view of the recent contract between the New York Central and the General Electric companies for eight 5,000-kilowatt generators and thirty 2,200-horse-power locomotives, it is safe to say that electrical apparatus is now considered quite as reliable as the old reciprocating engine.

Electric power began to take the place of horses for hauling street cars about the year 1888. The West End Street Railway Company, of Boston, did some of the early experimental work. In 1889 this company began the construction of the great West End power station which was then planned to be equipped with ten triple expansion Corliss engines of 1,000 horse-power each and forty belt-driven 200-kilowatt four-pole Thomson-Houston generators. Later plans called for thirteen engines and fifty-two generators.

The construction of the West End power station in Boston was the beginning of five years of great prosperity and progress in electric street railway work. In 1895 electric cars began to replace existing cable cars on street railways and steam locomotives on elevated roads. The Metropolitan West Side Elevated Railroad in Chicago, equipped with General Electric apparatus, began running trains in May, 1895. This was the first commercial electric elevated road in the United States. In June of the same year the Baltimore & Ohio Railroad Company began hauling trains through a tunnel under the city of Baltimore with an electric locomotive weighing ninety-five tons and equipped with four gearless motors of 360 horse-power each. The voltage of the system was between six and seven hundred. The total length of line electrically equipped was about three miles.

This year also marked the completion of the first of the 5,000-horse-power alternating-current generators in the Niagara Falls plant. These machines were not designed expressly for railway work, but they represent the beginning, on a large scale, of the generating of alternating-current power for railways. In 1896 the New York, New Haven & Hartford Railroad Company began operating some of its lines with electric power, in order to regain the traffic which had been taken from it by the electric interurban roads in its territory.

In 1898 the Sprague multiple unit system was put in operation on the South Side Elevated Railroad, thus completing the substitution of electricity for steam on all the elevated roads in Chicago.

The principal pioneer work of the past six years has been along the line of polyphase alternating-current central power plants for supplying power through substations to the standard direct-current motor equipment of electric railways. Three magnificent examples of this work have been designed to meet the transportation problems in New York city.

The first of these was the Metropolitan Street Railway Company's power station. This company operates all the surface cars on Manhattan Island, an area about ten miles long by two miles wide. The station equipment consists of eleven 3,500-kilowatt General Electric generators having an overload capacity of thirty-three and one-third per cent. Each machine is direct-coupled to a Reynolds-Corliss vertical cross-compound engine, and generates three-phase currents at a pressure of 6,600 volts. Power is transmitted at 6,600 volts from the one central station to the substations which are distributed over Manhattan Island from a mile and one-half to three miles apart. The substations are equipped with 1,000-kilowatt rotary converters, each converter receiving alternating current from three step-down transformers. The rotary converters supply direct current to the 500-volt feeder system. There is also a storage battery whose current capacity is about one-fourth the total capacity of the rotary converters in each substation.

The second notable piece of pioneer work, on a large scale, in New York city was the electrical equipment of the Manhattan Elevated Railroad. This system was put in operation only a little over a year ago. The power station was then the largest steam-driven electric generating plant in the world. The first electric trains were run over the road in January, 1902, and the complete change from steam locomotives to electric motors required about one year. The power stations, consisting of eight units, has a total capacity of 80,000 horse-power. Each unit consists of a 5,000-kilowatt Westinghouse three-phase alternator directly connected to a pair of cross-compound Reynolds-Corliss engines. Each generator has a safe overload capacity of fifty per cent and delivers 10,000 horse-power at 11,000 volts to the high-tension cables during the periods of maximum daily load. One hundred and twenty-five miles of these 11,000-volt cables distribute the power to seven substations.

The step-down transformers and rotary converters in the substations are similar to those of the Metropolitan system, the units being about fifty per cent larger. They supply power at 625 volts to the direct-current feeders leading to the third rail, which is used as the working conductor. There are four motor cars on each six-car train, each motor car being equipped with two General Electric motors. The eight motors on each train can be operated from either end of any motor car by the multiple unit system of train control. The cars are so arranged that the train may be cut in two in the middle, making two three-car trains with a motor car at each end of each train.

The last and most important step in the development and application of electric power for railroads, to be recorded up to the beginning of the year 1904, was the decision of the New York Central Railroad Company to equip with electric power all of its trains entering New York city. Such action by a conservative company is the greatest endorsement that could be placed upon the reliability of electric power. The plans call for a power station equipment consisting of eight 5,000-kilowatt steam turbine-driven generating units. This is equal to the power equipment of the Manhattan Elevated. The distributing system will also be similar to the Manhattan, and the locomotives are to be equipped with the multiple unit system of control so that two locomotives controlled by one man may be used on one train when desired.

The selection of the steam turbine as a prime mover instead of the reciprocating engine was justified by the results obtained in Chicago during the past five months. The performance of the 5,000-kilowatt turbine generator on the regular incandescent lighting load of the Chicago Edison Company has put the steam turbine beyond the experimental stage. This machine generates three-phase currents at 9,000 volts. It has the same nominal rating 5,000-kilowatts as the Manhattan alternator. The total weight of the steam turbine and alternating-current generator combined is about 200 tons and only about eight per cent more than the revolving field alone of one of the Manhattan alternators, or a little over half the weight of the Manhattan alternator complete exclusive of the engine.

There have been during the past year many other noteworthy developments in

[1] Paper read before the sixteenth annual meeting of the Iowa Engineering Society, Des Moines, January 22—Slightly abridged.

electric railway work, especially in the successful operation of alternating-current motors. This work has been of an experimental nature, no large amounts of capital being involved, but the experiments have proved successful and it is probable that the single-phase alternating-current railway motor will soon come into quite general use in this country.

There are in more or less general use at the present time four systems of electrical distribution of power for railways: first, the standard 500-volt direct-current system, using direct-current equipment exclusively; second, the rotary converter substation system, using alternating-current generators and direct-current motors; third, the booster system, consisting of standard direct-current generators and motors having in addition a special series-wound generator connected in series with one or more feeders supplying the more distant portions of the trolley line; fourth, the alternating-current system, using no direct-current apparatus whatever.

Probably the best example of the standard direct-current system in this country is the plant of the Boston Elevated Railway Company. This company operates all of the electric railways in the city of Boston with eight direct-current power stations. These eight stations have a total power output approximately equal to that of the Metropolitan alternating-current station in New York city, and they are distributed throughout the city in very much the same way as the Metropolitan substations. New York is committed to the alternating-current generating system, Boston is quite as consistently standing by the direct-current system, and Chicago is waiting for the politicians and capitalists to settle the franchise problem. It is a question whether the rotary converter substation system in New York is any better adapted to the needs of the city service than Boston's direct-current system.

Where interurban roads are to be operated in connection with city lines, the rotary converter substation system has the advantage because the same standard apparatus can be used throughout the entire system.

Most of the large cities have both alternating and direct-current generating stations. The direct-current stations supply the heavy city lines, while the alternating-current stations supply the interurban lines and with the city substations act as auxiliaries to the direct-current stations.

In a standard direct-current distribution system the amount of power wasted in the transmission line is often twenty or thirty per cent and sometimes even as much as fifty per cent.

The efficiency of the transmission and transformations between the alternating-current bus-bars of the New York Metropolitan power station and the direct-current bus-bars of one of the substations is between ninety and ninety-one per cent.

The booster system, often used as an auxiliary in a small city plant where the standard 500-volt direct-current system is not equal to the transmission requirements of one or more light suburban lines, has a rather low operating efficiency, for it is designed so that about 100 per cent of the power generated by the booster shall be wasted in the transmission line. Nevertheless, the booster system is often the most economical method of supplying power to a few suburban cars five or ten miles from the power station, especially when the traffic conditions call for its use for only a few hours at a time or only a few weeks during the year.

Where the power required by such a suburban road is too large to be economically handled by a booster system, the best method of meeting the demand is to install in the power station a standard rotary converter to be operated as an inverted converter.

Among the most promising systems using alternating-current apparatus exclusively, may be mentioned the following: the three-phase induction motor system recently used in Germany in obtaining speeds above 130 miles per hour, the Arnold single-phase induction motor system, and the system which is to be tried on the Washington, Baltimore & Annapolis Railway, using a single-phase series-wound commutator motor.

Concrete Railway Ties.

U. S. Consul J. K. Gowdy, at Paris, describes in a report the results obtained by the use of the Sarda concrete railway tie in France. These ties have as yet been used experimentally only. Four ties were laid down in October, 1900, on the State Railway in France, near a small depot about twelve miles from Bordeaux. They are made of reenforced concrete, and consist of a skeleton of five metal plates placed vertically and held in position by stout iron wire or thin bars. The interstices are then filled in with cement. A thin layer of compressed felt, about one-fifth of an inch thick, was put between the tie and the bolt heads. After being in use for one year the track inspectors reported that no fault could be found with them, but it was impossible to form any satisfactory opinion from the use of such a small number. The maker was therefore requested to make the number 100, and the additional ties were laid down between April 20 and July 1, 1902. In the new ties a slight change was made in the construction, so that bolts could be replaced without damaging the tie. The ties are rectangular, with rounded corners, and are slightly thicker where the track shoes are placed. Fourteen ties are laid for each thirty-six-foot rail. The greatest weight on a single driving wheel is about fourteen tons. The experiment has as yet not lasted long enough to enable any definite opinion to be formed, but no change in the condition of the ties has been observed since putting them down. However, in the opinion of the chief engineer of the State Railway, these ties will not bring about any economy in the cost of track construction, unless the cost of the ties themselves can be reduced considerably.

Another New Metal.

United States Consul-General Guenther, of Frankfort, Germany, under date of December 11, 1903, sends the following translation of an article which recently appeared in the Frankfort *News:* "A new metal which is similar to aluminum, but still of lesser weight, has been discovered by the French engineer Albert Nodon, and called 'nodium,' after him. It is manufactured by an electric process. In color, lustre and structure it is almost exactly like steel. Its specific weight when molten is only 2.4. Its resistance against breaking is given as about twenty pounds per square of 0.04 inch. Its constancy in the air is higher than that of aluminum. Its ductility is between six to eight inches; the malleability can be compared to that of bronze. It melts at about 600 degrees. It is suitable for being cast into forms. The conductibility for the electric current is as high as that of copper of equal weight. If natural power, especially water power, can be used for its manufacture, the cost in round figures is about fifteen cents per pound. The inventor expects numerous uses of nodium in the near future, especially for electric wires and cables, for light but strong parts of motor cars, torpedo boats, men-of-war, street cars, military outfits, air ships, etc., and for castings in place of bronze, German silver, and similar metals. Nothing definite has yet been communicated as to the chemical composition of nodium nor as to the mode of its manufacture."

CARE AND MAINTENANCE OF STORAGE BATTERIES—V.

BY EDWARD LYNDON.

ELECTROLYTE.

The electrolyte consists of dilute sulphuric acid, and the acid used should be in every case the so-called brimstone acid, as that manufactured from sulphide of iron contains arsenic, iron and other harmful impurities.

The density of the mixture of distilled water and brimstone acid when first put into the cells generally varies from 1.210 to 1.225 and in motor-car work the density is even greater, usually 1.235 to 1.255.

Lower densities, however, are to be recommended, as sulphatation is accelerated with high-density electrolyte and the deterioration is more rapid. This lowering of the electrolyte density would decrease the working voltage per cell, but the cost of a few additional cells to make up the total voltage required, if low-density electrolyte be used, would be more than compensated for if the life of the entire battery be prolonged.

When a cell is fully charged the density of the electrolyte is a maximum, and as discharge proceeds this density decreases continually, due to the formation of lead sulphate by combining of the lead oxides of the plates and SO_3 taken from the electrolyte. It also follows that on charge the density will continue to increase so long as the reduction of lead sulphate back to sponge lead and lead peroxide continues, and the electrolyte density will therefore vary between charge and discharge. This variation is dependent upon the amount of electrolyte in each cell, and while high densities are to be avoided, it is also necessary that the density at the end of discharge should not fall too low. This requires that if lower initial densities be used, a greater amount of electrolyte is required in order that the terminal densities may not be too greatly lowered.

It is common practice in this country to allow from fourteen to eighteen pounds of electrolyte per 100 ampere-hours. On the basis of fifteen pounds per 100 ampere-hours, with an initial density of 1.210, the variation in density would be from 1.210 to 1.175 approximately for a full discharge.

Acid density readings should be taken once each week in every cell, and as far as possible at the time when the battery is in the same state of charge or discharge, in order that different sets of records may be used for comparison. If the battery is composed of a large number of cells it is hardly advisable to insist on readings being taken at more frequent intervals as it is likely, in such a case, that the records might be filled out without the hydrometer having actually been used. Specific gravity readings, when carefully taken, form an excellent basis on which to study battery performance, as the density of the electrolyte is a reliable indication of the state of charge or discharge, provided the cells are perfectly normal; and any trouble will manifest itself by a change in density from the normal charge and discharge variation. When a battery is first put in commission, the acid should be carefully watched as differences in the plates in various cells will cause changes in density in the battery as a whole, and the changes from charge to discharge and *vice versa* will not be uniform.

In giving the initial charge and for several succeeding charges, the current should be continued until the acid density in each cell stops rising. At this point the density from cell to cell will be found to vary considerably, and to make all cells uniform some of the electrolyte should be drawn from those cells in which the gravity is too high and replaced by distilled water. If in cells which show too low a density the specific gravity can not be increased after several charges, it is then advisable to add small quantities of dilute acid, about 1.400, to bring the electrolyte to the proper density.

This addition of acid should not be made until such cells have been thoroughly examined, and it is definitely ascertained that this low density is not caused by short-circuits, local action or the like.

After the electrolyte has been equalized over the entire battery there should be no further addition of acid. It is essential that the plates at all times be completely submerged, and to take up any loss in solution by evaporation or spraying distilled water only should be added. Very little acid is lost by spraying and the amount that goes into permanent combination with the active materials is small, so that there is no danger to be feared from weakened electrolyte.

The more important times to take gravity readings are just after full charge and after discharge. If the discharge rate has been excessive the gravity readings should not be taken immediately. A short time should be allowed in order that free circulation may take place.

When a cell is subjected to high rates of discharge, those portions of the electrolyte that may be in intimate contact with the active masses will rapidly decrease in density, due to the fact that the SO_3 is extracted from these portions, going into combination with the sponge lead and the peroxide of lead to form lead sulphate; this rapid formation of sulphate decreases the ability of the electrolyte to circulate freely in the pores of the active masses and the cell electromotive force drops accordingly. For this reason time must be allowed for proper circulation before taking specific gravity readings after a high discharge. This applies with equal force to excessive charge rates as far as allowing time for circulation is concerned.

If the containing-tanks of a cell be very deep there will be a difference in acid concentration between the top and bottom layers—this may give rise to more rapid action on the bottom of the plates than on the top and thus result in buckled plates. In tanks of this nature the work and wear on the plates are not distributed uniformly, as shown by the fact that in very long plates the bottoms deteriorate much more rapidly than the tops, in fact some instances show the tops of the plates to be in good condition while the bottoms are worthless.

When tanks are very deep it may be necessary to keep the electrolyte in circulation by some artificial means such as an air blast, the air being introduced at the bottom of the tanks by means of rubber hose.

CLEANING AND REMOVAL OF SEDIMENT.

With the continued action of a battery there is a steady accumulation of sediment on the bottom of the containing-tanks or jars. This sediment is, of course, harmless so long as it does not touch the plates, but when its height is sufficiently great to bring it in contact with the plates, it immediately becomes a source of trouble and must be removed.

The method employed for removing sediment will depend upon the type of cell and somewhat on local conditions.

In the manufacture of tanks and jars for battery work, considerable space is allowed between the bottom edge of the plates and the bottom of the tanks and all this space is available for the accumulation of sediment, and usually it will be found that by the time this space has been completely filled that quite a large number of plates are worn out, so that in such cases the process of renewing the plates and cleaning the tanks can be done simultaneously.

If the battery is made up of small cells in glass containing-jars, connections being made by bolting the terminal straps, it is comparatively a simple matter to remove the element and then dump the sediment. This work can be done by dismantling the whole battery, taking it out

of service for a week or more, or one cell at a time may be attended to without interrupting the service from the battery as a whole.

If the elements be installed in lead-lined tanks with bus-bar connections, the matter of sediment removal is more difficult, and, under certain conditions, nothing short of dismantling the battery and dumping the sediment directly from the tanks will suffice.

If the tank capacity is greater than that of the installed element, leaving a space between one side of the tank and the element, it may be possible to remove the greater portion of the sediment by means of a scoop thrust down through the existing space; while all the sediment can not be got out, a sufficient quantity may be removed to obviate the possibility of a short-circuit.

This method has the disadvantage of producing a very dirty electrolyte, but this may be compensated for by the fact that the service is not discontinued

If the tanks be completely filled with plates it is necessary to dismantle the cell if the work be done effectively.

Batteries have been "flushed" out with indifferent success by a stream of water under high pressure; where the tanks are not too deep and if the sediment is not packed in this process will sometimes relieve the trouble. Flushing out tanks requires that the battery room be laid out to take care of a large amount of water that will be scattered around, and the resulting leakage from moisture will probably give rise to other troubles equally as interesting as short-circuits from sediment. To carry out such a method of cleaning requires a large quantity of water and patience out of proportion to the results obtained.

One ingenious method for removing the plates from a cell without cutting the bus-bar connections consists in lifting out of two adjacent tanks the plates connected to the bus-bar between them until the tank is cleaned; in this manner the plates in all the cells excepting those on the end of a row may be removed without cutting any of the bus connections.

Another method consists in arranging the cells when they are installed so that the liquid may be drawn off, by burning a lead pipe connection in the bottom of each tank, the outer end of this pipe being, of course, sealed. Tanks embodying this feature of construction can be readily relieved of accumulated sediment by cutting the seal on the outer end of the pipe, a new seal being burned on before acid is again poured into the tank.

RECORDS.

It is safe to assume that the majority of battery troubles are due directly to continued overdischarge or, what amounts to the same thing so far as occasioning trouble is concerned, undercharging. Of the two undercharging is probably the more prolific cause of trouble.

The last part of the charge being just as important as the first, it is essential that the current be continued until the battery exhibits every sign of full charge, regardless of the fact that the ampere-hours of charge, up to a certain point, may exceed the previous discharge by an amount sufficient to compensate for the losses in the battery. The several indications of full charge are: terminal voltage (which should be from 2.4 to 2.63 volts per cell, depending upon the rate of charge), density of the electrolyte, color of plates and gassing of both positive and negative plates. To ensure best results and as a preventive measure against trouble, it is imperative to keep a set of records of the battery as a whole and on each individual cell. Such records constitute a history, so to speak, of all battery operations, and in case of trouble developing they should form the basis for deciding the proper methods to be pursued to restore normal conditions. The kinds of records kept and the time given to taking them depend largely on the class of installation, it being evident that batteries operating in small stations with limited attendance can not get the same care as in larger stations where there may be one or more attendants whose entire time is devoted to the battery.

There are, however, certain records that are necessary and common to all classes of stationary batteries.

In order that such records be of any value it is necessary that they be carefully made and with some regularity. Carefully taken records at intervals of from one to two weeks are infinitely more valuable than those at much shorter intervals if the work be hurriedly and carelessly done. Since records are to be used comparatively and, further, as this comparison should be extended to individual cells as well as to the entire battery, it is necessary that separate cell records be made. The practice of obtaining data from only one cell, so-called "pilot cell," is not to be recommended and it is absurd to suppose that the performance of any one cell of a battery made up of, say, 255 such cells can furnish any idea as to actual conditions throughout the battery.

This method to an extent defeats the object of taking individual cell records, which is to ascertain if local trouble exists.

The pilot cell is a makeshift at best, and furnishes an excellent excuse if any difficulty develops in any other part of the battery. Usually the pilot cell never behaves in any but the most exemplary manner, thanks to judicious doctoring.

It has been pointed out that specific gravity readings of the electrolyte should generally be taken at two periods; namely, at or near the end of discharge and of charge. Specific gravity for some purposes gives a far more accurate idea as to the condition of cells than voltage, although both should be considered jointly. For instance, a sulphated cell may indicate 2.5 volts on the passage of the charging current and consideration of the voltage only would indicate full charge. The low acid concentration in this cell will, however, show the error.

In order that the data may be complete the voltage and acid readings should be taken at the same time, or one set of readings should follow the other in the shortest time possible, and the order for taking these readings is to observe the voltage first when the battery is nearing the end of the charge or discharge and the gravity readings taken as soon thereafter as possible.

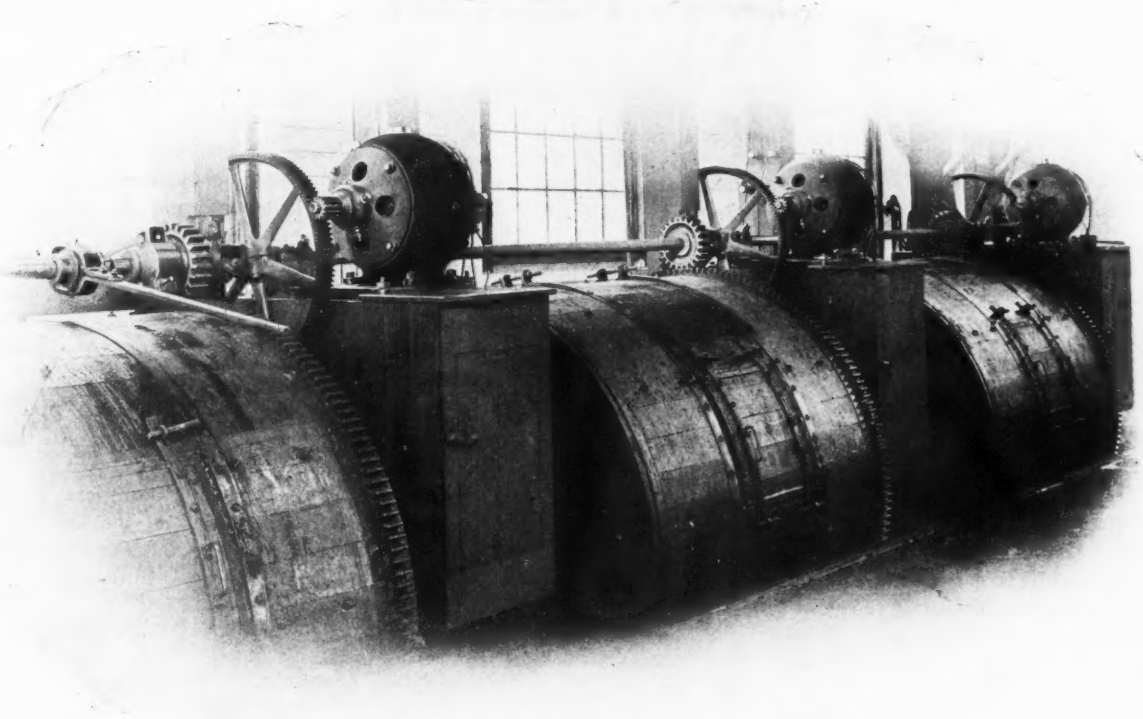
In observing the voltage the battery should always be under load, that is to say, current should be either passing to or from the cells. It has been previously shown that in case the rate of charge or discharge is excessive, time should be allowed for calculation of the electrolyte before observing the specific gravity. The usual variation in the density of the electrolyte between charge and discharge is from 1.210 to 1.180, and cells working normally should all read from two to fifteen points of each other, it being practically impossible to make the acid in all cells exactly the same density; but marked differences should be noted and the cause corrected.

Cell voltages should be taken and recorded with the same frequency and regularity as the specific gravity. It is, however, advisable to go over the battery much oftener with a voltmeter even if these readings are not recorded. As a matter of fact, successful operation requires that it be done every day, as this is a quick way of ascertaining if any other than normal conditions prevail; as it is to differences in individual cells from those in the remainder of the battery that we have to depend for finding local trouble.

Electric Power in Tanneries.

By George E. Walsh.

THE tanning industry represents large interests in different parts of the country, and the improvement in methods of tanning the finer skins for the fancy and novelty trade has marked a considerable advance in recent years. The big tanneries are located for the most part in regions accessible to the forests where supplies of hemlock bark can be had. In Pennsylvania and the Northwest the tanneries of modern construction have been built with the idea of utilizing electricity for their operation, and the introduction of this power in the plants represents an entirely new departure.



MOTORS DRIVING A BATTERY OF TAN DRUMS, REVERSIBLE MOTION AT WILL OF OPERATOR.

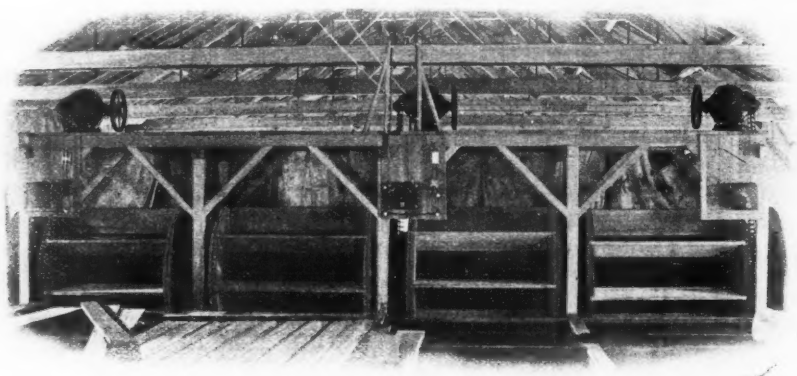
Tanning by electricity is to some extent a novelty, but there is hardly a new plant constructed, or an extension made to existing plants, that electricity is not employed as the motive power. One of the largest of these plants, and one that is to some extent the pioneer in the field, is located at Milwaukee. The plant is equipped with electrical machinery throughout from the great boomer press, which is used to compress the hides when piled one upon another, to the fleshing machines for cleaning the hides of all pieces of flesh and hair and the paddling or bate wheels employed for manipulating the hides so they will have a softness of surface that is equal to any worked entirely by hand.

The modern tannery must of necessity be distributed over a considerable territory, with each separate operation performed in buildings that are divided from all others. Because of this condition of affairs the old belting arrangement was always difficult and awkward, while the work of running steam pipes from one central station to the different buildings caused a considerable loss of power. More than this, it was found necessary to construct more substantial roofs and buildings to carry the heavy shafting and belts than is imperative under electrical installation. In short, there is probably fifty per cent of the power developed at the steam engine lost through line shafts, belts, pulleys and countershafts by the old method of tanning by machinery, and nearly one-third increase in the cost of building construction.

The development of electrically driven tanning machinery has been made a specialty of by several of the electrical manufacturing companies, especially the Northern Electrical Manufacturing Company, of Madison, Wis., which has installed such large tanneries as the Pfister & Voget tanneries, of Milwaukee, and the boot and shoe factory of F. Mayer & Company, of Milwaukee. The finest leather was formerly considered impossible of manipulation except by hand, but to-day machinery does nearly all the work. So delicate are some of the machines in operation that the most expert hand worker could not improve upon them. With the electrically driven machine directly under control, the hides can be handled so that the minimum percentage of loss is guaranteed. At critical stages in the process it is essential that a single machine be stopped in an instant Delay of a fraction of a minute may prove fatal to good work. The operation of each machine of each separate department by independent means thus places the electrical method far ahead of steam.

In designing the modern tannery engineers place some departments entirely under the control of a single large motor, while others are manipulated by several. The knife splitters and fleshing machines require separate motors. When unusually thick, tough hides get into the fleshing machine a maximum of power is required to prevent any slowing down of the machinery. To make the cut absolutely smooth and perfect, the operator must

have unlimited power at his immediate command, and this can be obtained economically only by means of a separate motor installed for the purpose. Frequently in the old way there was a complete stopping of the fleshing machine when a tough hide got caught in it either through the slipping of belts or unusual pressure thrown suddenly upon the line shafting by several machines at once.



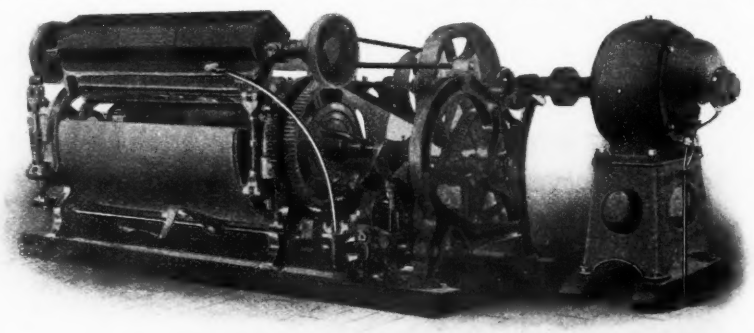
Back-Geared Motors Operating Paddle or Bate Wheels in Tannery.

The rollers, glassing machines, pebbling jacks, tan drums, bate wheels and fleshing machines are grouped in separate buildings so that individual units are formed. Wires running from the central station carry the power to the different groups of motors with the least possible expense of installation and cost of operation.

The proper planning of the factory and the grouping of the different units necessarily determine the expense of operation to a large extent. Electric tanning thus reduces the cost of manipulating the hides, and at the same time increases the daily output of a factory and improves the quality of the finished product. By the old hand method, or by steam operation, leather could not be finished off as carefully and perfectly as it is to-day in an electrically driven motor tannery.

The modern electrically driven tan drum is built so that it can be operated in alternate directions, which prevents the leather from getting tangled or wadded. The rapid reversal of the drum by the operator is an important gain, while the number of revolutions obtained at any moment can be changed immediately to suit the needs of the work. A battery of reversible drums is thus operated in some tanneries by a single five-horse-power motor so that the daily output is far in excess of all other methods. While the battery of drums arranged in a series alongside of each other can be operated together by a single motor, each one is stopped or reversed singly at the will of the man in charge. Consequently there is no danger of tangling or wadding in any of them.

The motor-driven belt-knife leather splitter is a somewhat delicate and intricate machine that has been developed through years of careful engineering experiment. This machine is generally directly connected with a small motor under the charge of an experienced operator. The machine gives a perfect finish to the goods, and increases the value of the finer grades of leather by making the split much thinner. The loss through imperfect splitting was a considerable factor in the older tanneries, especially where costly and expensive hides were handled. Fully ninety per cent of this loss has been eliminated by the new motor-driven machines, which makes the operation independent of all the rest of the factory.



Motor Driving Fleshing Machine in Tannery.

The motor-driven fleshing machine saves fifty per cent over another driven with shafts and belts, while the daily output is increased by about thirty per cent. The fleshing machine is directly connected to a motor, and is operated singly and not in groups. The operator has his machine under the most perfect control, and the least indication of imperfect work enables him to stop the machine and regulate the feed. The leather is thus rarely injured, and an imperfect hide seldom comes forth from the fleshing machine.

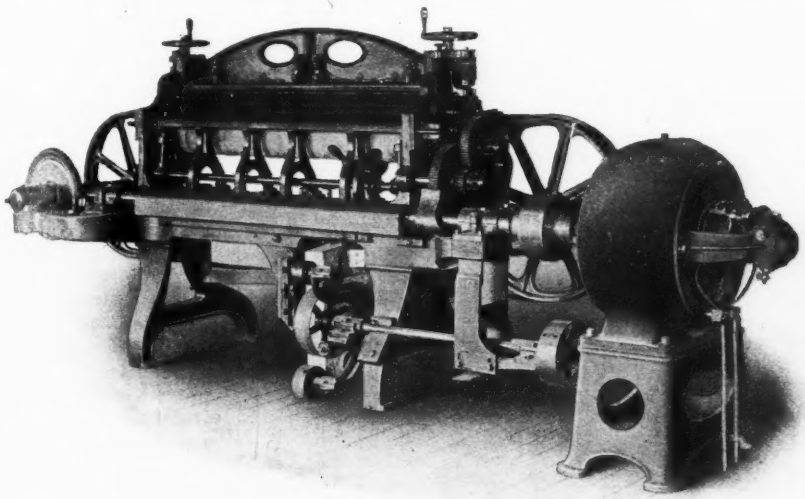
The motor-driven shoddy and sole leather rollers are important machines in the average tannery. Here heavy slabs of shoddy leather are rolled. The shoddy is composed of layers of thin scrap leather pasted together, and then put through the heavy rollers under extreme pressure. The slabs of leather are over a foot thick, and powerful machines must be used to handle them. After being pressed sufficiently the slabs of shoddy are cut in thick pieces by the leather splitters. The utilization of the shoddy leather in this way marks an important advance in modern tanning. This waste formerly represented an item which in the aggregate amounted to large sums. The electric-driven rollers are arranged in batteries, usually with a separate motor directly connected with each one.

Pebbling jacks are also geared to electric motors, and also boomer presses of great power. The latter are operated so that almost any pressure desired can be obtained at the will of the operator. The boomer press is sometimes run upon a small track, with an overhead motor, which operates both the movement of the presses up and down, and the running of the machine on the track. In this way the press can be easily taken to any part of the tannery for operation. Under the old system of steam, the boomer press was not portable, and the hides for pressing had to be carted to the press. The saving in time and expense by means of the electrical portable press is a considerable factor in modern tannery economy.

Even small motor-driven hair washers are provided to-day for the up-to-date tannery. A small overhead motor is geared to the washer by means of a chain and sprocket, and the operator standing below

can regulate the machine at will. Sometimes the small pump for supplying the water is operated by the same small motor that runs the washer. The coupling of the two to one motor saves space and power

The paddle or bate wheels of a tannery



Motor Driving Belt-Knife Leather Splitter.

are generally operated in couples by motors. A single motor thus runs each set of two wheels, which are back-geared and reversible at will. A battery of such wheels arranged in a straight line in the tannery has the small motors mounted on a framework above the wheels where they are in plain sight and away from all interference with the work. Between each two wheels the motors work with uniform regularity under conditions of the greatest economy.

The electrical installation of a modern tannery makes it cheap and economical to increase the size of the plant when business demands it by simply running additional wires to the new extension and putting in a few more motors. It is this feature of the new tannery idea that adds greatly to the popularity of electrically operated machines. Under almost all kinds of obstacles the tannery can be increased in size. Even when located in cities where it is impossible to secure more adjoining land to extend the size of the plant, the wires can be run to buildings a quarter or half a mile distant to operate some new department.

The Electrical Magazine.

The first issue of the *Electrical Magazine* has come to hand. This is a technical journal, devoted to the advancement of electrical science and industry. It will endeavor to cover all branches of the art and science, and will contain, in addition to original contributions by recognized authorities, brief abstracts of all the important articles appearing in electrical journals. The journal will be divided into sections, each being conducted by a specialist, and in each section will be given all articles of interest in that particular field.

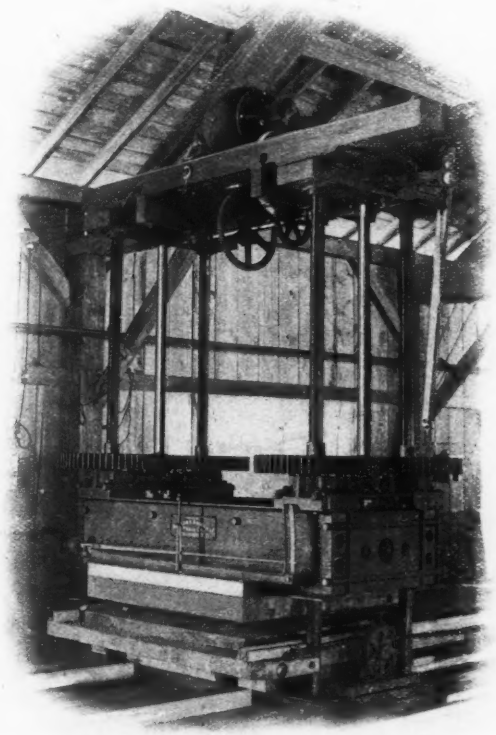
The first number contains 112 pages of interesting matter on electrical subjects. Among other articles may be mentioned contributions by A. C. Eborall, on "Poly-phase Generators;" "The Theory of Alternators," by Alfred Hay; "Electric Traction for Railways—Some Considerations and Warnings," W. M. Mordey; "Prospective Changes in Railway Signaling," by J. Pigg; "The Importance of Electrochemistry," by Sherrard Cowper-Coles; "Electrophysical Research," by G. W. de Tunzelmann; "Industrial Electrometallurgy," by J. B. C. Kershaw; "Artificial Loads for High-Tension Three-Phase Generators," J. P. Kemp.

The magazine is edited by Thomas Feilden, well known as the proprietor of *Feilden's Magazine.* Among the associate editors and literary contributors are E. Bignami, J. A. Fleming, G. Fords, A. Gray, H. M. Hobart, E. Hopkinson, Rankin Kennedy, T. Mather, John Perry, Sir W. H. Preece, Sir David Salamons, Arthur Schuster, F. Soddy, J. Swinburne, C. A. Carus-Wilson.

The magazine is published at 4 Southampton road, Holborn, London, W. C., England.

Worcester Polytechnic Institute.

The thirty-fourth annual catalogue of the Worcester Polytechnic Institute, Worcester, Mass., gives an interesting sketch of the foundation and development of



Back-Geared Motor Driving Boomer Press in Tannery.

that well-known school, and a full discussion of the courses of study offered in mechanical, civil and electrical engineering and general science.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—XII.

NOTES ON PROGRESS IN EUROPE AND AMERICA.

BY JOHN B. C. KERSHAW.

Lead.

In the note on this subject published in the ELECTRICAL REVIEW of March 28, 1903, the writer referred to the Salom and the Betts processes for obtaining lead by electrical methods. In the first of these, galena (lead sulphide) is employed as raw material; while in the second, the lead bullion obtained from the silver-lead ores of the mines in the western states is used as anode material in the vats. Since the date of the earlier note on this subject, the plant of the Electric Lead Reduction Company, at Niagara Falls, where the Salom process is in operation, has been rearranged and an improved form of decomposing cell has been introduced. The inventor has recently described the modified form of cell before the American Electrochemical Society. The chief improvements relate to the means adopted for preventing the escape of sulphuretted hydrogen gas, and for lessening the time required for complete reduction of the galena. The new cell is of the rotary form, and the bottom of the cell, which functions as cathode, takes one and one-half hours to complete one revolution. The charge of ore placed upon it is entirely reduced to spongy lead in this time. Seventeen cells of the new type have been installed at the Niagara Falls works, and experiments are now being carried out relating to the utilization of the sulphuretted hydrogen gas which is at present wasted.

As regards the Betts process, which is worked at Trail, in British Columbia, the inventor has also been discoursing on his process before the members of the American Institute of Mining Engineers. The inventor, in this paper, gave tests of the lead produced in the cells, of the bullion used as raw material, and of the slimes; and although no figures were given for the output of the works at Trail, the paper is one of considerable value to all interested in electrometallurgy. It is stated that twenty-eight vats, each holding three tons of lead bullion when fully charged, are operating at Trail, and that each of these yields 750 pounds of lead per day of twenty-four hours, with a current of 4,000 amperes. As theory demands a yield of 823 pounds on this amperage, the current efficiency of the process is ninety-one per cent, and is fairly high for a process of this character in which impure anode material is employed.

The difficulties caused by "treeing" of the lead deposited at the cathode have been overcome by the use of gelatine or glue in the vats; and the electromotive force required per pair of electrodes is only 0.35 volt.

The Betts process would therefore appear to have a successful future before it, in spite of the criticism by Dr. Haber in his recent report upon the electrometallurgical industries of the United States. According to this authority, the commercial development of the Betts process is hampered by the fact that the best method of working up the slimes has not been settled; but this should not prove an insuperable difficulty.

Luckow's process for manufacture of white lead by electrolysis is reported to be at work at Wengerohr on the Moselle, in Germany. The plant consists of ten cells, and the yield of white lead is stated to be between 3.5 and 4.0 kilogrammes per kilowatt-hour. The electrolyte consists of a mixture of sodium chlorate and carbonate, and the electrodes are of lead. This is believed to be the only works of the kind in operation.

The Calcium Carbide Industry in England.

In the note upon Calcium Carbide Patents, published in the first series of these notes, in the ELECTRICAL REVIEW of January 24, 1903, the writer referred to the failure of the Acetylene Illuminating Company to uphold the validity of the Willson carbide patent in the United Kingdom, and to the fact that the manufacture of calcium carbide was now an open industry in that country. The defeat of the Acetylene Illuminating Company in its appeal case, over twelve months ago, has not led, so far as the writer is aware, to any great development of carbide manufacture in the United Kingdom, and only three companies are believed to be at present engaged in the production of carbide.

At Foyers the British Aluminium Company is still manufacturing carbide for the Acetylene Illuminating Company, but at the annual meeting of the company held in November, 1902, it was stated that the manufacture did not pay, and that unless better terms could be secured from the Acetylene Illuminating Company (the selling agent) the manufacture of carbide at Foyers would cease. The extension of the generating plant at Foyers which is now occurring, is attributable to the progress of the aluminum—not of the carbide—industry; but at the last meeting of the company held in July, 1903, the chairman stated that considerable reduction had been made in the cost of carbide manufacture at Foyers, and that its production would be continued. At Widnes, Lancashire, the United Alkali Company is believed to be making small quantities of carbide, as required by its customers, in the Duff electric furnace; but the manufacture is not being pushed at all by this company, since the electric power has to be generated from coal, and is relatively more costly than at Foyers.

At Ingleton, Lancashire, a small water power has been devoted to carbide production, in the Parker type of furnace, for some months, and in June, 1903, a company named the Acetylene Gas and Electric Smelting Company, with a capital of £28,000, was floated, in order to purchase and carry on the works. Considerable extensions of the plant and machinery are now in progress.

The price of carbide in the United Kingdom has fallen considerably during 1903, and the November quotations of the Acetylene Illuminating Company are from fourteen shillings to sixteen shillings per hundredweight, at Foyers, and two shillings higher at its various distributing centres throughout England. The use of acetylene dissolved in acetone is considered to be the most promising recent development in the acetylene-lighting industry, and a considerable extension of this branch industry is expected. Acetylene is also coming into favor for metallurgical and blow-pipe operations. According to a recent research by Fery, the temperature of the acetylene flame under ordinary conditions of burning in a Bunsen burner is 2,548 degrees centigrade, or 120 degrees centigrade higher than that of the flame of the oxy-hydrogen blow-pipe.

Telephones on Trolley Cars.

The Schenectady Railway Company, Schenectady, N. Y., will install a system of telephones on its Troy and Albany interurban lines in a short time. These telephones will be placed in the cars running on these divisions, and will be so arranged that communication may be held with the office in Schenectady at any point along the line. The system will be simple and comparatively inexpensive. Two ordinary telephone wires will be strung the entire distance along the tracks. Each car will be provided with a telephone of the hotel type, which is compact and requires little space. These telephone will be placed inside the car, near the door, and will be connected with wires to a jointed rod long enough to reach to the wires on the poles beside the tracks.

In order that communication may be established with the office, it will be necessary to put the rod together and hang it upon the two wires by means of two hooks which are connected with the wires leading to the telephone.

The Annual Dinner of the American Institute of Electrical Engineers.

Mr. Thomas Alva Edison the Guest of Honor. The Twenty-fifth Anniversary of the Commercial Application of the Incandescent Lamp. The Founding of the Edison Medal.

THE annual dinner of the American Institute of Electrical Engineers was held in the main ballroom of the Waldorf-Astoria, Thirty-fourth street and Fifth avenue, New York city, on the evening of February 11, 1904. At this dinner Mr. Thomas A. Edison, whose fifty-seventh birthday the occasion commemorated, was the guest of honor. An informal reception was held in the small ballroom from six-thirty to seven-thirty o'clock. There was a remarkable number of early arrivals, and by seven o'clock fully ninety per cent of the diners were on hand.

The main ballroom, where the dinner was served, was beautifully decorated with trailings of incandescent lamps and smilax. Behind the guests' table were elaborate decoration and the state banners of Ohio, New Jersey and New York. Immediately behind Mr. Edison was a picture of his birthplace at Milan, Ohio. The tables were splendidly decorated, and a most enjoyable repast was promptly begun at eight o'clock. By ten o'clock the dinner had been served, and President Bion J. Arnold, of the American Institute of Electrical Engineers, called for order, opening the intellectual proceedings with the following message to Mr. Edison from President Roosevelt.

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MR. THOMAS ALVA EDISON.—Photographed by Falk, February 11, 1904.

I congratulate you as one of the Americans to whom America owes much, as one of the men whose life work has tended to give America no small portion of its present position in the international world.—THEODORE ROOSEVELT.

After the reading of this message, a standing toast was drunk to the President of the United States. President Arnold then delivered the opening address, saying, in part:

It will thus be seen that our organization attempts to combine and place in harmonious relationship for efficient work the physicist, or theorist, the practising engineer of to-day, and, through our students, the electrical engineer of the future, and secure for them, through our associate membership, the close relationship and financial strength so essential to the accomplishment of great engineering works, and in which support we could with pride place the names of almost every executive officer of our great electrical institutions, and many others, who, by their ability to judge men and things, have so efficiently and loyally supported us through the experimental periods until success brought emoluments to us both.

Although the electric light came into commercial use in 1880, followed soon by the electric motor, our Institute was not founded until 1884, but since that time the growth of our membership may be taken as indicative of the rapid development of the art in which we are engaged, until we now have a membership of about three thousand active minds, one-fifth of whom are full members, scattered not only throughout every state and territory of the United States of America, but throughout almost every country where civilized man exists.

These men are now engaged in teaching, investigating or quietly designing, installing or directing the operation of properties which have, by the combined efforts of the engineer and capitalist, in addition to increasing the comforts and conveniences of mankind, been mainly instrumental in adding to the material wealth of the world something over four thousand millions of dollars.

Nearly thirty years ago, when as a boy in the public school of a western prairie town, I was designated by my teacher to write a biography, I chose as my hero the man whom we honor to-night. My boyish efforts were the best that I could command, and while I aspired with the great hopes and ambitions of youth for a career of achievement, my environments were so foreign to those necessary for a technical calling that I little dreamed I would ever have the honor of representing such colleagues on such an occasion as this.

While I realize that important ceremonial events have taken place during the administrations of my predecessors, and that similar events will take place during the administrations of my successors, I am grateful that this particular event has happened now, and that I am allowed the privilege and pleasure of again paying tribute to the hero of my youth.

We have met on this, the day of our annual feast, to not only renew those friendships incidental to those engaged in a common cause, but to assume an obligation which if administered faithfully by us and our successors shall tend to stimulate the ambitions of many of our student class and bring to some of them that intangible something called "Success." If you ask me what is "success" I can not answer, but those whose ambition it is to add to the sum of human knowledge or to accomplish something for the advancement of the race, need no answer.

It is to this class of young ambitious men that our attention is directed to-night, and if, in the future, they need inspiration let

them recall this occasion and remember that around these tables sat men who were the exponents and active agents of one of the greatest forces in Nature, and that through their achievements in mastering this silent force there was effected in a brief period of but little over twenty years one of the greatest advancements in material wealth and scientific knowledge in the history of the world.

Either around these tables sit or associated with us in similar societies across the waters are the men who, through their efforts, have converted our cities from darkness into day; increased the range of human speech; bridged our oceans for the transmission of intelligence, with and without wires; made it possible to preserve the human voice long after the speaker has passed away; emancipated the horse; made accessible the energy of the water power of the world, and who are gradually eliminating the element of distance in the transmission of electrical energy until the steam locomotive, formidable rival that it is, may ultimately be superseded.

The engineer has waited long for recognition, but it may be truthfully said that this is his age, for no longer is his work misunderstood by the intelligent. It is now recognized that the preparation necessary to enable him to discharge his duties in the higher branches of his profession is as arduous and as thorough as are those required for the other great professions.

Furthermore, it is recognized that while great works have been accomplished in the past and are now being carried on by engineers who were not technically educated in their youth, but who succeeded in spite of the difficulties incident to such careers, the changes which have taken place during the last decade make it necessary, for those who aspire to excel in this calling, to take their technical courses early and thoroughly. While our guest this evening is a distinguished example of what can be accomplished without such a training, he, nevertheless, after having taught himself and many others, recognizes the tendency of the times and by his participation in these exercises lends his name and his influence in the right direction for the guidance of the youth of the future.

Therefore, as the dean of the greatest technical school of the world, through which the graduates of all other schools must pass —the school of practical experience—and in which he has eclipsed us all in individual achievement in those arts which tend for the material benefits of the race, do we recognize him, and by these ceremonies honor ourselves in thus honoring and officially perpetuating the name of Thomas Alva Edison.

Mr. Arnold introduced the toastmaster of the evening, Mr. T. C. Martin, who addressed the audience, opening his remarks with the stanza from the poem of Schiller:

Well for the world if there be found a man
Who makes himself what Nature destined him,
The pause, the central point of thousand thousands.

I need offer no apology if, upon the occasion of this great anniversary, I venture to apply these words to the man of light and leading, who is our guest of honor.

As President Arnold has so admirably said, the American Institute of Electrical Engineers numbers and embraces in its membership the leading inventors of the age as well as its greatest captains of industry; and I am sure you will agree with me that it could find no worthier hero and no greater boon to mankind to signalize than the man and the theme around whom to-night we twine the laurel wreaths of our admiration and our love. It is no meteoric career that flashes momentarily upon our dazzled gaze to-night; but one of steady glow and stately swing across the starry heaven of achievement. We who have witnessed through long years the creative work of this man in its wide orbit have often felt that it was a phenomenon as unusual in its elements as the resistless onrush of Niagara or the slow uplifting of new continents from ocean bed for the occupancy of mankind where before there existed barely foothold even for the hovering imagination. And yet while it is no meteoric career, in whose life story we pass a milestone, it has been adventurous and romantic to a degree—it has been broadly, typically, wholly American. In whatever country had been born the man whose birthday we associate with this great anniversary, he would have carved his way to his own. In this country, in this Republic, whose name is a synonym for freedom and liberty, one of whose fathers was also our father—Benjamin Franklin—this worthy and modest successor of his has been freer than he would have been anywhere else in the world to work his discoveries and his inventions, to enlist the capital and the labor equal to their exploitation, and to be welcomed by a public ever ready for every new thing that adds to the resources of civilization. I have ventured to associate the name of our guest of the evening with that of Benjamin Franklin, as one whom we expect to see, in future years, alongside of him in the American Hall of Fame.

We are met to-night on the eve of a great national birthday, and as we recall the humble beginnings, the steady toil, the gradual uplift, and the ultimate conquest over inconceivable difficulty by splendid and patriotic genius, we rejoice in the conviction that the characteristics of Abraham Lincoln, as exemplified in another sphere and on another plane of action by our guest of honor to-night, are not dying out from among us; and not only on the lofty plane of noble deeds do we detect the personal similarity between the two men, but also in the genial attributes of humor and of sensibility do we find that we are at close grips with both of them in the true American.

And now, as I am about to take leave of our guest of honor, let me say, as President Arnold has said, and others will say, that the founding of this medal should be an incentive and an encouragement to every ambitious youth in America, and should lead them to recall the lad in the modest hamlet in Ohio, the cheery little newsboy in Detroit, the half-shod, half-frozen operator struggling bravely for a job along the icy pikes of the Central States, the untutored experimenter in Boston, taking eagerly fees for lectures on electricity that he was too modest to deliver, the embryonic inventor in New York, grub-staked by a far-sighted Wall street banker with his first stockticker; the deaf investigator at Menlo Park; taking splendid retaliation on his affliction by preserving forever with his phonograph our human speech; the prolific patentee for thirty years keeping the pathway to the Patent Office hot with his footsteps, and the man who, taking in his Promethean hand this crystal bulb, gave to us and the world a new and glorious light such as never was before on land or sea—Thomas Alva Edison —charge your glasses, lift them high, shout three cheers to him.

After the toast had been drunk and the applause had ceased, it was announced that Mr. Edison would telegraph his response to Mr. A. B. Chandler, president of the Postal Telegraph-Cable Company. This message was sent over a Western Union "quad" and received on a Postal "quad." Mr. Edison transmitted the following message over the telegraphic wire:

I want to thank you first of all, my fellow members of the American Institute of Electrical Engineers, for the great honor done me in thus celebrating my birthday, associated with the twenty-fifth anniversary of the completed development and successful introduction of the incandescent lamp. Your expressions of good will gratify me deeply. While I can not but rejoice at the place which the incandescent lighting art has made for itself among the inestimable comforts and conveniences of civilization, I feel that my share in the work is exaggerated by this prominence given me to-night.

To my old friends and associates who have founded the Edison Medal in the Institute, I can but extend you thanks again. If I could do it in return, I would found a medal for every one of you, for you are just as much entitled to recognition as I am. You gave me your friendship and loyalty; your watchful days of toil and sleepless nights of anxiety. Some of you helped to perfect the art by your engineering skill, your legal ability, your financial aid.

The early days were enough to tire out any one's courage and persistence, but you stood it all, and you put up with me into the bargain. Now, in noble revenge, for the burdens I put on you and in addition to all the evidences of friendship in the past, you add this unusual token of continued affection. I should not be human if I were not profoundly affected and deeply grateful.

This medal is founded to encourage young men to devote their best thought and work to electrical development. I rejoice in this stimulus to harder study. Better trained and educated than were we pioneers of the times before every college and university had its electrical course, these coming men of the future should, and I believe will, carry forward to triumphs and arts heretofore undreamed of the principles and applications of electricity to which I have tried humbly to devote my life and energies from the hour my hand first touched the key. God bless them, and you, my dear friends, and this American Institute of Electrical Engineers.

The following messages were read amid cheers.

From the governor of Ohio:

Ohio claims a large share in the glory of Mr. Edison's career by reason of the good start she gave him. The people of Ohio are deeply interested in his great achievements and rejoice over the fame he has won.

Speaking as the representative of Ohio, and for myself, I join you in felicitations to the guest of honor, and extend to him my best wishes for many years more of usefulness.—Myron T. Herrick.

From the governor of New Jersey:

I am glad to know that the American Institute of Electrical Engineers propose to do special honor at its annual dinner to Mr. Thomas A. Edison, a distinguished citizen of New Jersey, whose remarkable achievements have been an honor to his state and country and of the highest usefulness to mankind.

Few men in history have found so wide a range for their inventive genius, and perhaps no one has contributed more by his inventions to make life safer, or more enjoyable, or happier, than he. New Jersey is proud of him, not alone for his wonderful achievements, but for those sterling qualities of manhood that make his life a model and an inspiration to all.—Franklin Murphy.

From the governor of the state of New York:

Will you be kind enough to extend to Mr. Edison my sincere congratulations upon his fifty-seventh birthday? It is hard to realize that so many wonderful achievements could be crowded into the brief space of years since Mr. Edison arrived at manhood. It is still more difficult to appreciate the full

effect of his inventions—what they mean to the civilized world in added comfort, economies, in expediting business and in bringing the whole world in closer communication.

With the friends who will surround him on this occasion I beg to join in extending best wishes for many years of usefulness and honor.—B. B. ODELL, JR.

From President Francis, of the Louisiana Purchase Exposition:

Extend my warmest felicitations to Mr. Edison and assembled guests. I wish to express my admiration for the genius of mind and craft of hand that has accomplished so much in a quarter century, and I hope the presentation of electricity at the coming universal exposition will fittingly evidence these great achievements. The exposition is honored in having Thomas Alva Edison high on the roll of its honorary chiefs.

From the mayor of the city of New York:

I am truly sorry that I can not be with you to do honor to Thomas A. Edison, for I recognize the spirit which prompts you to celebrate the birthday of a man whose genius brought into the world new forms of beauty, light and power.

By the establishment of the Edison medal you at once do honor to a distinguished American and offer fresh inspiration to the youth of our land.

Let me share with you the hope that we may long have him with us to rejoice from year to year in the achievements of his brain, to which human progress now owes so great a debt.—GEORGE B. MCCLELLAN.

From Mr. Carnegie:

It is most unfortunate that I can not be present when the "King of the Telegraphers" is to be crowned with the medal crown. Though absent, yet I here profess to the monarch loyal and unfaltering allegiance, swearing to render him at any and all times such service as the most potent head of the clan that ever ruled his people, ever received from his humble and devoted subjects.

To which I hereby pledge our life, our fortune, and our sacred honor. Long life, "King Edison the First."—ANDREW CARNEGIE, liegeman to King Edison the First. "73" to one and all.

From Lord Alverstone, lord chief justice of England:

Hearty good wishes to Mr. Edison. I look back with greatest interest to his brilliant inventions in electric lighting and telephony which I had the greatest pleasure of successfully maintaining in all courts in England.

From Lord Kelvin:

I join heartily with the American Institute of Electrical Engineers in gratitude to Edison for his great electric work and for the phonograph, a most exquisite and instructive scientific discovery, and for his many other useful and well worked out inventions for the public good.

From a leading electrician of Italy, Professor Colombo:

I enthusiastically join in the honors paid to-day to my dear and illustrious friend Edison, whose system I am proud to have introduced first into Italy.

From Hungary, from De Fodor:

Admiring your great inventions, Hungarian friends send sincerest congratulations.

From a leading electrician of France:

The electricians of France send their heartiest congratulations to Mr. Edison on the occasion of the ovation in his honor.—MASCART.

From the electrical engineering body of Germany:

Hearty congratulations to our honorary member of the Elektrotechnischer Verein.—EMIL NAGLE.

From Gisbert Kapp:

Greeting and kind wishes to American Engineers. Congratulations to Edison on the twenty-fifth anniversary of his invention of the glow lamp.

From the president of the Italian Society of Electrical Engineers, Rome, Italy:

Fraternal greetings to the American Institute of Electrical Engineers.—ASCOLI.

From the Institution of Electrical Engineers of England:

The Institution of Electrical Engineers of England tenders fraternal greetings to American Institute on occasion of annual dinner.—GRAY.

Mr. Samuel Insull, as chairman of the Edison Medal Association, presented the Edison medal fund and deed of gift to the Institute, saying, in part:

I take pleasure, Mr. President, in handing you this trust deed, with the full confidence that the medal will be bestowed for all time to come in the manner intended by the donors.

It is an especial personal pleasure to me, as one of Mr. Edison's old employés, to be associated with this movement for the purpose of doing honor to the illustrious guest of the evening and as marking the twenty-fifth anniversary of the introduction of the "Edison incandescent lamp." The development of a vast industry of electric light and electric power with which so many present are associated dates (with the exception of series arc lighting) from the original work of Mr. Edison on the incandescent lamp. If you wish to trace the early history of the arc you need scarcely go further than the records of the United States Patent Office, where you will find ample evidence to show that Mr. Edison is beyond all question the father, and I might almost say the creator, of this great lighting industry.

Those prominent and distinguished experimenters who, prior to and contemporaneously with Mr. Edison, sought to produce a commercial incandescent lamp, followed the path hewn out for them by the early series arc light experimenters. They, as a result, made the mistake of producing a low-resistance lamp operating in series, and consequently requiring a varying potential, resulting in a system impossible to operate on a large scale. It remained for Mr. Edison, with a foresight almost supernatural, to see that what was needed was a constant potential system which would respond to the demand of every kind of service, and as a result he gave us the high-resistance lamp, the multiple arc and feeder systems embodying principles which all successful inventors have since been compelled to employ in their distribution systems—whether dealing with direct or alternating currents, with systems of lighting (except series arc lighting), and with systems of electrical power, whether moving or stationary. In short, Mr. Edison gave us as the result of his brilliant inventive work at Menlo Park the cardinal engineering principles of the great industry with which his name is so intimately associated, and in making these contributions to scientific and industrial progress he achieved such a position that I think posterity will not adjudge us of undue enthusiasm if we name him as the greatest electrochemical experimenter and the first electric light engineer of his day.

It is not alone as the experimenter and inventor as the mathematician and engineer of this industry for which Mr. Edison is entitled to recognition. It should be borne in mind that at the time of his first exhibit of his light and power system on a considerable scale at Menlo Park in the winter of 1880, there were no factories for the production of the apparatus required for use in connection with the system, nor were there in existence, except in their crudest state, any of the numerous appliances used between the generator and the lamp, and which have since become every-day necessities. These appliances had to be developed and factories for their manufacture organized before it was possible to build the first plant and distribution system.

Professor A. E. Kennelly accepted the Edison medal fund and deed of gift on behalf of the Institute. He wished, on behalf of the American Institute of Electrical Engineers, to voice the universal sentiment in expressing the appreciation of the cause which had been founded as a worthy and enduring monument to the fame of Mr. Edison. Not only did this incite enthusiasm in the young man, whose age is set forth in the deed as not to exceed twenty-five years; nor did it only enhance the fame of Edison and perpetuate it in future years, but it also stimulated those institutions in which the future Edisons may be trained and engendered a generous rivalry and emulation among the alma maters of the United States.

Professor Cyrus F. Brackett, of Princeton University, responded to the toast, "Electricity in the Universities and Colleges."

Professor Brackett stated that it was with feelings of lively satisfaction that he accepted such a responsibility as the founding and purpose of the medal conferred. It was fit that such a medal be provided to bear witness to the skill and triumphs of the modest man who was honored upon this occasion. He had a very lively recollection of the difficulties as they were encountered by his colleague, Professor Young, and himself when it was attempted to make measurements of the apparatus existing when Mr. Edison first worked upon the solution of the central station problem. When the first trip was made to Menlo Park, at Mr. Edison's suggestion, there were taken such instruments as the university then possessed. This apparatus consisted of a resistance box, a Thomson high-resistance galvanometer and two accurately weighed copper electrodes of very large size. The current amperes were found by the electrolytic method; the potential difference between the brushes of the dynamo by

THE MAIN BALLROOM OF THE WALDORF-ASTORIA, NEW YORK CITY, ON THE OCCASION OF THE ANNUAL DINNER OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, FEBRUARY 11, 1904.

comparison by means of the high-resistance galvanometer and a gravity battery of many cells. As a check, the energy in a conductor of normal resistance was determined, a barrel of water being used for a calorimeter. The measurement of power was equally roundabout.

He thought that a word or two in relation to what the colleges and universities can do for the student would not be out of place. They should provide courses in which the mathematical theory of electricity should be thoroughly taught and mastered. Practical courses in electrical measurements and in the testing of electrical appliances should illustrate the theory. As preparatory to such work, the student should be well versed in the English language, so as to express himself clearly and easily, and should have a working knowledge of French and German. That he should have a thorough grounding in mathematics goes without saying. Physics and chemistry should, of course, be insisted upon, for electrical engineering is only the special exploiting of these sciences.

In response to the toast, "The Association of Edison Illuminating Companies," its president, Mr. Joseph B. McCall, welcomed the opportunity of paying his humble tribute to the distinguished man whom the association was honoring. The Association of Edison Illuminating Companies sprang into being shortly after the adoption of Mr. Edison's system as a commercial possibility. It was formed in 1885, the first meeting being held in April of that year. Five companies formed the nucleus of that organization, and of the original delegates he believed Mr. Insull, of Chicago, was the only one now actively connected with the association. The purpose of the organization was the cooperation of the member companies, the exchange of experiences in operation, and mutual help and protection. The association has grown from five companies in 1885 to seventy-two in 1903. The year 1882 saw a total production of incandescent lamps of only about 100,000. Ten years later the total consumption in this country amounted to about 4,000,000 per year, and in 1903—practically twenty-one years after the manufacture of incandescent lamps was commenced in commercial quantities—the total consumption in the country reached about 45,000,000 per annum.

The closing address of the evening was delivered by Mr. Charles L. Edgar, president of the National Electric Light Association. Mr. Edgar said, in part:

The National Electric Light Association is very glad to take its part in paying tribute to Mr. Edison and to the twenty-fifth anniversary of the introduction of an incandescent lamp. I think it is especially appropriate that this association should pay its tribute to the well-known man who is the guest of honor this evening. This association has been in existence during nearly the entire twenty-five years, or at least that portion of it in which the incandescent lamp has been in commercial use. It is composed of companies using all kinds of lamps and systems, and it is perhaps above all others the most impartial of those qualified to express an opinion as to the part which Mr. Edison's inventions have taken in the history of the lighting industry. Some of us who have been identified with what is commonly known as Edison companies do not fully appreciate the advantages under which we have been working for so many years. It really takes an outsider to fully express the relative value of the Edison system as compared with all others. We know that while we are still using almost item for item the same devices that were put upon the market over twenty years ago, we do not as fully realize, as some others, that this is peculiar to the Edison system, and that other inventors and other designers of systems have seen their inventions and their designs cast aside, while what is known as the Edison system stands to-day almost exactly as it stood twenty-five years ago. How much of the tremendous growth which we have seen in the lighting industry during this time is due to Mr. Edison it is hard to measure. This is not the place for statistics, but if it were I could quote columns of figures, all of which would simply prove that the Edison companies, measured by their size and importance to-day, are in as fully a great majority as at any time since the introduction of the incandescent light. This may be due to accident, either of place or of condition, but I for one think it is due to the genius of him whom we are here to honor to-night.

I do not know who is responsible for the idea of the Edison Medal Association; whoever he is he deserves our thanks. I can conceive of nothing more appropriate than founding a fund, such as has been described here to-night, for the purpose not only of perpetuating Mr. Edison's memory and his work and his genius, but of perpetuating it among the class of young men to whom we must look for future development. I think it is particularly appropriate that the gold medal is to be given to the best work done by a member of the graduating class of one of our universities. I do not think that in the past there has been a very tangible connecting link between the students of our colleges and the men whose places they are to take in later life. I do not know how much the parent organization of the American Institute of Electrical Engineers is doing here in New York to bring them closer together. I do know, however, that the branch work which we are attempting to do in Boston and which I have no doubt is being done in other university centres is bound to have a very considerable effect in bringing closer together the students and the men engaged in the electric light industry in general. My recent connection with the Boston branch has shown me this more clearly than ever before. We have, as you all may know, in our vicinity Harvard and the Institute of Technology, both having at least two large organizations of students taking an electrical course, and I venture to say that until the branch was organized scarcely any of them knew even by sight the class of men whom they themselves were likely to become in later life. What the branch work has begun in this respect will be made much more definite and tangible by the work inaugurated by the Edison Medal Association, and those in charge of its inception and carrying out are to be congratulated on having chosen a field, above all others, in which it will do the most good.

Having spoken now for the National Electric Light Association, and in a way as a member of the American Institute of Electrical Engineers, I can not refrain from saying that above all of this I am an Edison man. There are many in the room here to-night who have probably been associated with Edison interests from the beginning. There are, however, comparatively few who can say with me that they not only have been connected with companies bearing the name of Edison for over twenty years, but have never been actively connected with any other company bearing any one else's name. I remember that when I went to Menlo Park in 1882 and was told to report at Garrick street to Charles L. Clark and W. S. Andrews, I considered it an honor to be connected with anything that bore the name of Edison. Twenty-two years later I am still of the same opinion. I know of no business in the world which is so interesting and has so many opportunities as the business in which the most of us are engaged. I know of no phase of our work which is so pleasant or so thoroughly satisfactory as the associations which we are able to continue with Mr. Edison and with Edison men. Some of us in recent years have seen very little of Mr. Edison himself; but I for one can say that in looking back to my earlier associations with him, whatever may be my feelings of admiration, of honor and of respect, more than half of the total is made up of my feeling of affection. It is not necessary for me to try to say anything which will add to what has been said to-night regarding the work done by Mr. Edison. I visited Menlo Park while in college, in 1880, and had my first glimpse of the incandescent lamp over the billiard table in the restaurant alongside the station. Looking around us here to-night, with the myriads of lamps, and looking beyond this room and this building, and this city and this country, I can but realize that there have been many changes, but notwithstanding all this we have the same unchanged Mr. Edison.

After Mr. Edgar's address, the toastmaster announced that the photographer of the New York Edison Company would make a photograph of the assembly. After the exposure had been made the ceremonies were at an end, the guests carrying with them the recollection of the most successful dinner which the Institute has ever held.

A handsome souvenir was presented to each guest in the form of a pamphlet elaborately embellished and containing the menu, programme of exercises, organization of the Institute, the details and organization of the Edison Medal Association. There was also a beautiful Ives process print of the bust of Mr. Edison, an original poem by Mr. R. R. Bowker, and each souvenir was autographed by Mr. Edison. This souvenir was the work of the Orr Press, New York city, and the prints of Mr. Edison were presented to the Institute by the New York Edison Company.

The gentlemen were presented with carnation favors, accompanied by a gold stick-pin, holding a miniature incandescent lamp. The lamps were presented to the Institute by the General Electric Company.

The sherbet was served in fancy boxes,

the cover of which was also preserved as a souvenir. This was a relief replica of the "Genius of Light," done by Bordiga in Italy, and now at Mr. Edison's laboratory in Orange, N. J.

A novel feature of the exercises of the evening, in connection with the telegraphing of Mr. Edison's response to the toast given to him, was a complete installation of poles, cross-arms and wiring. This carried the circuits across the hall. In addition to this there was a wireless sending and receiving station.

Interpolated in the circuit which conveyed this telegraphic response were a number of historical relics of sections of wires and cables, representing a most interesting contribution to the evening's entertainment. This contained a section of the piece of wire over which Professor S. F. B. Morse sent the first message by the Morse telegraph. The second section was a piece of the original telephone wire over which the early experiments in the transmission of audible speech were made at 75 Exeter place, Boston, Mass., in 1875 and 1877. The third relic was a section of the Atlantic cable, over which the first successful message was sent under the ocean. The fourth was an electric safety fuse or plug used in London on January 12, 1882, to close the circuit of the first incandescent lamp ever lit from an electric lighting central station. The fifth was a section of the trolley circuit erected at Richmond in 1883. The sixth was a section of the deep-sea portion of the new American-Pacific cable. The seventh was a section of the circuit used on April 22, 1896, to light, by means of vacuum tubes, the lecture room of the American Institute of Electrical Engineers. The eighth relic was a section of the cable through which the first power was transmitted electrically from the Niagara Falls electric power plant on April 16, 1895. This collection of circuits was loaned to the Institute for this occasion by Mr. William J. Hammer, the well-known engineer of New York city.

Both the Western Union Telegraph Company and the Postal Telegraph-Cable Company extended every courtesy to the Institute in the reception and transmission of messages and cablegrams before and during the evening. The Postal Telegraph-Cable Company, in celebration of this event, printed a special telegram form. This, in addition to the company's regular heading, contained a suitable memorial inscription.

Among those at the guest table with Mr. Arnold and Mr. Edison were Professor C. F. Brackett, Mr. John Fritz, Mr. Samuel Insull, Mr. C. L. Edgar, Dr. A. E. Kennelly, Mr. Joseph B. McCall, Colonel R. C. Clowry, Mr. A. B. Chandler, Mr. G. G. Ward, Mr. John J. Carty, Mr. C. A. Coffin, Mr. Ambrose Swasey, Professor Elihu Thomson, Mr. W. H. Fletcher, Mr. W. J. Wilgus, and Mr. T. C. Martin.

Mrs. Edison was seated at a table immediately in front of the guest of honor, and was accompanied by the wives of the guests, among whom were Mrs. Arnold, mother of the president, Miss Arnold, Mrs. A. B. Chandler, Mrs. C. W. Price, and Mrs. G. G. Ward. General Eugene Griffin, Mr. W. H. Baker and Mr. Calvin W. Rice were also at this table.

The decorations were planned and executed by the New York Edison Company, the "Elblight" system of twin conductors allowing of the greatest flexibility and utility. The large photograph of Mr. Edison was made by Falk in his studio at the Waldorf-Astoria. The group photograph was made by the photographer of the New York Edison Company. As this was made late in the evening a number of the guests had left the room, and it does not include all of those who attended the dinner.

A Variable Electric Speed Gearing.

At the recent Paris Automobile show, among other interesting novelties was a variable speed gear used in connection with a gasoline engine. This gear consists of two small electric generators, one coupled to the driving and the other to the driven shaft. Upon the latter shaft is mounted an armature with a continuous-current winding. Around this and concentric with it is the field casting, which is driven by the engine. This field carries on its outer surface the core and windings of a second generator, and around this again there is a second field casting, running loosely on the shafts.

This arrangement gives two concentric generators, the armature of the outer machine being coupled mechanically to the field of the inner. Various speeds are obtained by various groupings of the electric circuits. At standstill the two armatures are connected in opposition, with the result that no current flows and there is no drag upon the driven shaft. Upon shunting the external field, the electromotive force developed in the corresponding armature is less than that of the inner armature. A current then will flow and cause a turning effort to be exerted upon the shaft. The next speed is secured by short-circuiting the brushes of the inner machine. The third and fourth speeds are obtained by connecting the two armatures in series, the external field first being shunted, and second, without the shunt. In the latter case the speed of the driven is about twice that of the driving wheel. At the second speed they are the same except for slippage. The two machines are used as brakes by connecting the resistances across the brushes.

Wireless Telegraphy and Its Use in Nautical Work.

At the recent convention of the Deutschen Nautischen Vereins (German Nautical Association), an address was delivered by Dr. Rudolf Vlochmann, on "The Use of Wireless Telegraphy in Nautical Work." This address has since been published by Herr B. G. Teubner, Leipsic.

LETTERS TO THE EDITOR.

Construction Apparatus Wanted.

To the Editor of the Electrical Review:

The construction and equipment of a preserved meat factory on a large scale in this country having been placed in my hands, and wishing to employ for preference American material and machinery, I should be much obliged if you would insert a paragraph in your well-known paper advising American manufacturers to send me their catalogues, price lists and other details of the following machinery:

Refrigerating plants, abattoirs, air compressors, boilers and economizers, steam engines, condensers, electric light and power plants, pumps, hydraulic presses, ventilators, fertilizer dryer, rendering plants, steam cookers, etc. Machinery for the preparation of extract of meat, peptone and tinned meat, and for making tins, for mechanical workshop, cooperage and carpenter's shop.

Utensils for iron and brass foundry.

Metallic roofs, filtration systems, pipes, hoist, cranes, trucks, rails, cars, etc., as well as all material, implements and accessories connected with this industry.

Correspondence solicited in French or Spanish when possible.

A. De Permentier,
Calle Rivadavia 5566.

Buenos Aires, January 12.

Single-Phase Repulsion Motors.

To the Editor of the Electrical Review:

My attention has fortunately just been called to a letter from Mr. Gaston appearing in your issue of November 7, 1903.

In referring to my paper on "Repulsion Motors," read before the British association, Mr. Gaston mentions the troubles of (1) sparking and (2) low power-factor, and suggests certain remedies which might be tried.

The first of these is that used by Mr. Heyland in his compensated polyphase motor and may be described as a commutator having a certain electric leakage. In answer to Mr. Gaston's query as to whether I have used such a device I may say that Mr. Fawssett and I constructed such a commutator in 1900, but came to the conclusion that troubles with the core were almost as bad as the original evil. The commutator was made of segments whose individual resistances varied. This was attained by the use of carbon combined in varying proportions with clay and other bad conductors. Thus the first segment (which closed the coils) was almost pure graphite, the second seventy-five per cent

graphite, the third fifty per cent graphite, and so on until the resistance was practically infinite. I enclose a photograph of the commutator, now in my possession. With this device the motor, indeed, ran sparklessly, but after two hours the commutator was hot and other evils appeared. The graphite segments wore away more quickly than the others, the different coefficients of expansion of neighboring segments caused the commutator to get out of true. This and the expense of construction decided us to abandon it, and I imagine that some of these evils will not be wanting in some of Mr. Heyland's commutators. Of course, in the latter only a small portion of the rotor current passes by way of the brushes, while in the repulsion motor, at any rate at starting, it is essential that the bulk of the rotor current should pass that way.

With regard to the second suggestion made in Mr. Gaston's letter, I may say

COMMUTATOR, WITH COMPOSITION SEGMENTS.

that I have tried this, too, and agree with him in the power-factor control which results when the motor is running. We have then, of course, a special case of the series alternating-current motor, and I am glad to find that Mr. Gaston (as well as I) has tried this motor, since it goes to prove with M. Latour's statement, *viz.*, how old some of the ideas are covered by Dr. Winter's recent patents. It would be interesting to see how far this patent could be upheld in a court of law.

However, even with this power-factor control, I do not regard the motor as very superior to the simple repulsion motor, because the power-factor of the repulsion motor need not be low while running, but only when starting with maximum possible torque; and this disadvantage (which is, of course, shared by all induction motors) is cured neither by Mr. Gaston's suggestions, nor by Dr. Winter's, nor M. Latour's. Indeed, it would seem to be impossible to alter it with any simple alternating-current motor, for at starting the actual power of the motor must be zero, while the current flowing in must have some fairly large value. Thus, if the starting current is no greater and the power-factor no less for the repulsion motor when compared with polyphase induction motors, it will stand a fair chance for use on traction lines, where three-phase is at present proposed.

WILLIAM CRAMP.

The Crypto Works, London,
December, 1903.

The Grounding of Secondaries.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of February 8, 1902, you published my letter of February 1, "Safety of Consumers and Grounding of Secondaries." One of the cases touched upon in my letter was Martinek *vs.* Swift & Company, of Cedar Rapids, Iowa, and I commented on same as follows:

It is to be hoped, in the interest of life and limb of consumers of electric light, that an appeal will be taken, as otherwise a very bad precedent would be established. It goes without saying that the electric light company should be made absolutely responsible to guard against the entering of the high potential into the secondaries and should provide safeguards, so that if such an entrance should occur, the dangerous potential should at once be relieved. The latest underwriters' rules recognize these facts and permit the grounding of the secondaries by permanently grounding the centre of the secondary coil in the transformer, but, of course, it is easily understood that the grounding of any other point of the secondaries, intentionally or accidentally, would be an absolute safeguard to human life against the high-tension current. If the verdict as given should stand, it would simply mean that if a citizen invites a friend into his house and he should by accidental contact with a socket get a fatal shock under circumstances similar to the one explained, the host and not the electric light company would be responsible for his death, if it could be shown that the wiring in the building in which the accident occurred should have been a little defective in some minor points. The absurdity of such a proposition is, of course, apparent to every electrical man, and it is to be hoped, in the interest of the protection of human life, that the Supreme Court of the State of Iowa will reverse the verdict.

As I had been the expert for Swift & Company, it is highly gratifying to me to just learn that the Supreme Court of Iowa on the fifth of February, 1904, has filed an opinion in this case reversing the judgment of the lower court. I quote a few passages probably most interesting to your readers:

It was not negligence for the defendant to use a brass socket. They were then in universal use on secondary circuits, not only in Cedar Rapids but everywhere, and were then and are now considered absolutely safe so far as danger to life is concerned. The fact that they will not resist a current of 1,000 volts is not proof of negligence, for the defendant only contracted for a safe commercial current of electricity and was bound only to supply proper appliances for its safe use. We are constrained to hold that the evidence on this branch of the case is wholly insufficient to support the verdict.

* * *

Unless the defendant in some way caused the defect in the converter it can not be charged with liability for its defective condition. It was a consumer only, having no control or authority over any part of the light and power company's plant, wires or converters. The secondary circuit was brought by the company to the defendant's office, and it had no control over any part of the system except the wires within its office and car.

The plaintiff seems to have thrown out a drag-net hoping to prove some act of negligence on the part of the defendant which would bring her a verdict. She succeeded in getting the verdict, but a very careful examination of the record convinces us that no negligence on the part of the defendant was proven and that the verdict is wrong.

But little need be said regarding the other errors argued.

The testimony of the witness Fawcett was incompetent, because he was admittedly not an expert. It was also error to admit testimony foreign to the issue presented by the pleadings, and such testimony was received. The eighth instruction was the law of the case whether right or wrong, and should have been followed by the jury and a verdict rendered thereunder for the defendant.

Instruction ten asked by the defendant should have been given. It told the jury that if a verdict was found against the defendant it could not recover the amount from the light and power company.

The jury should have been instructed to find for the defendant on the whole case. It is unnecessary to mention other errors. For those pointed out, the judgment is reversed. F. B. BADT.

Chicago, February 12.

Annual Report of the Lighthouse Board.

The annual report of the Lighthouse Board for the fiscal year ending June 30, 1903, has been issued, giving a record of the work accomplished during the year.

A New Book on Wireless Telegraphy.

Mr. William Maver, Jr., New York city, announces that Maver's "Wireless Telegraphy, Theory and Practice," would be issued on February 15, 1904.

Wisconsin Telephone Convention.

Proceedings of the Fifth Annual Convention of the Independent Telephone Association of Wisconsin, Held at Milwaukee, February 10 and 11, 1904.

THE meeting was called to order Wednesday afternoon at two o'clock in the convention hall of the Pfister Hotel. The president, Mr. Richard Valentine, of Janesville, delivered his annual address, showing that the independent telephone companies throughout the state were still making wonderful progress; that all companies had greatly increased their list of subscribers and that new exchanges were being built in some of the important cities and still others were being completed; that numerous toll lines were constructed and some copper lines were built, and the prospects for copper line construction the present year were very good. The company now installing an independent exchange in Chicago had given assurance that this year it would connect with the independent companies of surrounding states, and no doubt most of the sections of Wisconsin would have long-distance service to that city by the end of this summer. He spoke at length upon the telephone legislation that the association had tried to secure at the last session of the legislature, and particularly upon the bill prohibiting discrimination in telephone rates which had passed the house by a large majority but was lost in the senate by only one vote. Most of the Wisconsin companies will soon have long-distance service to the wholesale cities of Duluth, Superior, Minneapolis, St. Paul and Dubuque on the north and west, and Sheboygan, Racine, Kenosha and Chicago on the east; and if the business men of Milwaukee realized how extensive the independent telephone business had become in this state and were alert to their own interests they would demand that an independent franchise be granted in the city of Milwaukee, as otherwise much business that would naturally come to the metropolis of the state will be diverted to those other cities.

Mr. J. C. Harper, president of the Dane County Telephone Company, Madison, delivered an address on the "Legislative Prohibition of Discrimination in Telephone Rates," referring particularly to Bill 603, A, which was a measure draughted by the committee of legislation appointed at the last annual meeting and for whose passage the officers of the association labored so hard only to be defeated in the senate at the last moment by one vote. The measure if passed was constitutional as the legislature has the power to regulate public service corporations and this bill sought to regulate, in a measure, the telephone business. The proposed law divided the cities of the state into classes according to population and required a telephone company operating exchanges in more than one city to charge the same rates for similar service in all cities in the same class.

Mr. Ferdinand discussed the address at length, pointing out the many beneficial features of such legislation.

Mr. Goodrich, of the La Crosse Telephone Company, spoke in regard to the postmaster-general's order, issued some time ago, ordering local postmasters to have the independent telephones removed from the post offices and substituted by the Bell instruments. He stated that the postmaster at La Crosse had received such an order, and that the postmasters of Minneapolis and St. Paul had been notified to have removed the interior systems, which had been installed in the post offices in these two cities by the local independent companies, and have similar systems installed by the Bell company, and that this order has been carried out. Mr. Ferdinand advised the appointment of a committee to draught resolutions concerning the postmaster-general's order, and the following were appointed: Messrs. Goodrich, Ferdinand and Twining.

Mr. Ferdinand moved that a committee of three be appointed to call upon the officers of the Badger State Telephone and Telegraph Company to ascertain their policy in regard to competing with other independent lines, and the motion being carried the following committee was appointed: Messrs. Ferdinand, Murdoch and Kellyn. A motion being made that a committee on resolutions be appointed the chair appointed Messrs. Hutchinson, Little and Teasdale. A committee of three was appointed to ascertain the plans of the Chicago Automatic Telephone Company in regard to connecting with the independent companies of Wisconsin, as follows: Messrs. Ferdinand, Kellyn and Valentine. Adjournment was then taken until 10 A. M. Thursday.

The meeting reconvened and Professor G. W. Wilder, professor of telephony in the Armour Institute, Chicago, made an address on "Improvement in the Telephone Service." He made many valuable suggestions in regard to service in general; stating that prompt service is essential and operating expenses should not be cut down at the sacrifice of good service. The problem the telephone man has to meet is to give the subscriber the best service and yet pay a fair return on the investment. Managers should keep themselves fully informed as to latest apparatus and improvements and be up to date. Parties conducting a telephone business should incorporate as otherwise they are partners and personally liable for debts, damage suits, etc. Cross-talk was an ever-present evil and hard to contend with, but should be kept at a minimum. Party lines usually were more profitable than separate line service, and if properly grouped would give satisfactory service. The various lockout systems are no longer experimental and are now being extensively installed. Pay telephones should be put in for the convenience of the public and are always found very profitable. The cost of underground construction work has been greatly reduced the last few years and is now being put in more generally than in the past and is sure to pay in the long run.

Mr. Hutchinson presented the report of the committee on general resolutions which was adopted as follows:

WHEREAS, The Independent Telephone Companies of Wisconsin have covered the state with a network of lines which connect local exchanges whose subscribers outnumber those of the Bell company three to one, and

WHEREAS, The independent toll lines will be connected with Chicago during the present year, and are now connected with the wholesale cities of Dubuque, St. Paul and Minneapolis, all of which does and will divest much business from the city of Milwaukee to those cities of adjacent states, now therefore, be it

Resolved, That the attention of the citizens and business men of Milwaukee be advised of this growing loss of business to the metropolis of our state, to the end that encouragement and aid shall be furnished any attempt to establish a local exchange in the city of Milwaukee to connect with the independent exchanges of the state. And be it further

Resolved, That a copy of this resolution be furnished the press of the city of Milwaukee.

WHEREAS, It is evident that certain

persons unfriendly to independent telephone interests have been in attendance upon the sessions of this convention, therefore be it

Resolved, That some rule or regulation be adopted so that only persons bearing credentials endorsed by the company represented and by the secretary of this association shall hereafter be admitted to the meetings of this or future conventions of this association.

WHEREAS, Certain manufacture and supply houses, and certain telephone and electrical journals have done much good work in advertising this meeting of our association, therefore be it

Resolved, That the thanks of this association be extended to all who have contributed to the publicity of our association, and be it further

Resolved, That the thanks of the association be extended to our retiring officers for their faithful work in the cause of independent telephony in the past.

Mr. Bell urged that a committee be appointed for securing additional members to the association, which was appointed as follows: Messrs. Bell, Kepler and Twining.

Mr. Goodrich then presented the following resolution:

Resolved, That a committee of five be appointed to whom shall be referred the proposition for long-distance service between Wisconsin and any other state contemplating a contract for more than one year between members of this association and members of any other company, and further that the secretary be directed to notify all the members of the association of this resolution, together with the names of said committee with the request that no contract for inter-state long-distance service be entered into until such committee has been notified of the general character of such contract and its approval thereto be had.

The resolution was adopted and the following committee was appointed: Messrs. Little, Hutchinson, Teasdale, Van Middlesworth and Ferdinand.

Mr. H. Durant, of the Chicago Automatic Telephone Company, stated to the convention that the company would connect for long-distance purposes with the Wisconsin independent companies which had good toll lines, and assured the members that all rumors to the contrary were without foundation.

Dr. Keelyn presented the following resolutions of his committee which were adopted:

Resolved, That a committee of three be appointed to whom shall be referred all disputes or questions of differences arising between any three members of this association; or disputes between members of the association and toll lines or exchanges of non-members when such disputes or questions arise from the alleged preferred rights of connection with an exchange or toll line of such parties or either of them; such committee to have power to arbitrate such matter so far as possible.

The following committee was appointed: Messrs. Wilder, Veeder, Schernecker.

Adjournment was then taken until two o'clock.

Meeting reconvened and Mr. Goodrich presented a resolution in regard to the order of the postmaster-general, which was adopted.

On motion made and carried that a committee on legislation be provided the following committee was appointed: Messrs. Harper, Hutchinson, Ferdinand, Larson, Valentine and Cavanaugh.

Mr. Twining reported the resolution of his committee as follows, which was adopted:

WHEREAS, It is desired that every independent telephone company of the state become a member of this association, it is hereby

Resolved, That the different members of the executive committee are hereby especially requested to use their personal efforts to secure as many companies as possible, located in their respective districts, to join the association during the coming year; and further, that the traveling men of supply and manufacturing companies, who are members, be requested to do what they can to secure new members.

The following companies made application for membership, and on motion were accepted:

F. Bissell Company, Toledo, Ohio.

Cambridge Telephone Company, Cambridge.

Columbia County Telephone Company, Morrisonville.

Fulmer Lumber Company, Florence.

Indiana Consolidated Telephone Company, Weyauwega.

Kingston Telephone Company, Kingston.

Mazomanie Telephone Company, Mazomanie.

Oxford & New Haven Telephone Company, Oxford.

Signalphone Company, Milwaukee.

The secretary read his report for the year showing the continued rapid growth of the independent telephone business in the state, and of the association which now comprises sixty-four active and twenty-five associate members, embracing, approximately, three-fourths of the independent telephone interests of Wisconsin. During the past two years ninety new telephone companies were incorporated in the state, with one and one-half millions of capital; and to-day there are in Wisconsin 250 independent telephone companies with an investment of three and one-half millions, with 1,200 toll stations, 350 exchanges and 35,000 subscribers, of which number about 8,000 are rural subscribers.

Mr. Harper urged the adoption of a design to advertise local and long-distance toll stations and that the association secure a supply of such designs and sell them to the members, and such motion was adopted. The motion was made and carried that a committee be appointed to interest the citizens of Milwaukee in securing the installation of an independent exchange in the city and the following were appointed: Messrs. Alfred Weller, A. B. Ferdinand and Wilmer Seig.

On motion the following officers were elected for the ensuing year:

Richard Valentine, Janesville, president.

H. G. Slater, Waupaca, vice-president.

H. C. Winter, Madison, secretary and treasurer.

Members of the executive committee: C. W. Twining, Monroe; G. Huette, Sheboygan; J. C. Harper, Madison; W. F. Goodrich, La Crosse; Julius Thielman, Merrill; John M. Baer, Appleton; E. A. Miller, Hixton, and J. C. Crowley, West Superior.

It was moved and adopted that the next annual convention be held in the city of Milwaukee, February 9 and 10, 1905.

EXHIBITORS AND REPRESENTATIVES.

Adjustaphone Company.

American Electric Telephone Company—C. P. Garst.

J. Andrae & Sons Company—Herman Andrae, J. C. Schmidtbauer, A. E. Stadelbauer.

Automatic Electric Company—H. S. Durant, A. G. Rousseau.

F. Bissell Company—M. S. Walker.

Central Electric Company—W. W. Geisse, J. W. Mason.

Electric Appliance Company—S. A. Dinsmore, J. B. McMullen.

Electric Supply Company—L. W. Burch.

Elliott Addressing Machine Company—R. St. John.

Eureka Electric Company—Herbert Rosenow.

Fulmer Lumber Company—D. M. Fulmer.

Green Telephone and Electric Company—F. J. Whittemore.

Holtzer-Cabot Company—E. R. Harding.

Illinois Electric Company—C. W. Bacon.

International Telephone Supply Company—H. H. Davenport.

Kellogg Switchboard and Supply Company—F. E. Rotchka, W. B. Hind.

Miller Anchor Company—G. H. Miller.

Monarch Telephone Manufacturing Company—E. E. Yaxley, W. H. Trim.

Nordstrom Lockout Telephone Manufacturing Company—William Herron.

J. A. Roebling's Sons Company—W. H. Slingluff, Bond Wisler.

Signalphone Company—A. D. Weller.

Standard Telephone and Electric Company—J. H. Parish, W. A. Taylor.

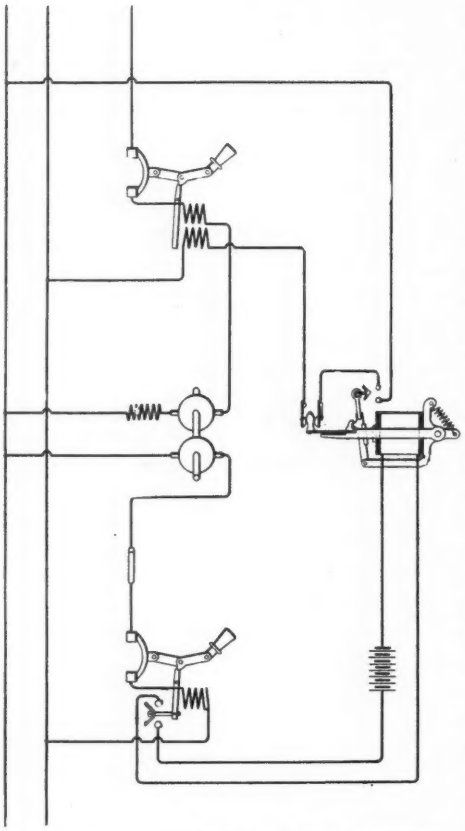
Sterling Electric Company—W. E. Doolittle.

Stromberg-Carlson Telephone Manufacturing Company—Don C. Gould, H. A. Jones.

Vought-Berger Company—M. I. Berger, D. W. Campbell, A. Meinama.

Electrical Patents.

The General Electric Company is the assignee of a patent recently obtained by Mr. Edward M. Hewlett, of Schenectady, N. Y., on means for controlling electric boosters. In operating constant-potential systems it is frequently desirable to raise the potential on particular feeders either to compensate for an excessive drop due to the length of the feeder or for greater than normal drop due to temporary or periodical increase of load. For this purpose devices known as "boosters" are employed, by means of which the potential of the main generator need not be raised

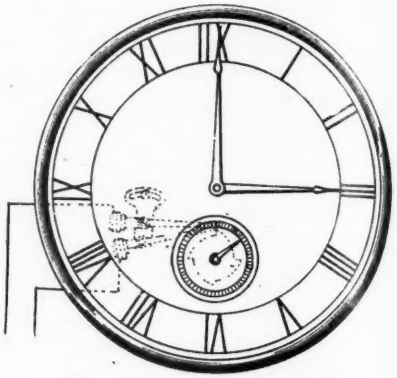


MEANS FOR CONTROLLING ELECTRIC BOOSTERS.

above a point which is sufficient for the main bus-bars which supply the system. Mr. Hewlett's invention relates to a system of this kind in which the boosters are driven by electric motors supplied from the distributing bus-bars. In such an organization if by reason of an overload or any other cause the fuse or automatic circuit-breaker controlling the motor circuit be blown, the booster, being connected with the bus-bars through the feeder, will operate as a series motor, rapidly accelerating in speed until it is torn apart by centrifugal force. It is the design of this invention to prevent such a consequence. Provision is made for automatically disconnecting the booster from circuit when the motor is cut out. The invention may be carried out in a variety of ways. One which has been employed in practice successfully consists in including in the booster circuit an automatic circuit-breaker provided with an auxiliary tripping coil energized or controlled by a local battery circuit closed when the motor circuit-breaker is tripped.

Mr. Adolf J. Marschall, of Little Falls, N. Y., is the inventor of an exciting compound for batteries, which is especially applicable to so-called "dry" batteries, but may be used for wet cells as well. In carrying out the invention a liquid is employed which consists of an aqueous solution of zinc chloride, ($ZnCl_2$) with an addition of ammonium chloride (NH_4Cl), the proportion of ammonium chloride being small as compared with the proportions hitherto employed in similar mixtures. By thus changing the proportions the life of the cell, it is claimed, is materially increased by diminishing the destructive local action. The best results so far have been obtained with a liquid composed as follows: water, one hundred parts, by weight; zinc chloride ($ZnCl_2$), eighty parts; ammonium chloride (NH_4Cl), six parts. The water and the zinc chloride form a solution of the specific gravity of 1.47. Experiments have shown, it is stated, that satisfactory results are obtained with even thirty to forty parts of zinc chloride to one hundred parts of water and from one to ten parts of ammonium chloride. However, it seems that the solution containing a higher proportion of zinc chloride gives the cells better keeping qualities.

An electric circuit-closer and breaker has been invented by Mr. Thomas H. McQuown, of Biggsville, Ill., the invention consisting in a mechanism comprising a movable part, preferably clock-controlled and operated, and two other movable parts moved one in advance of the other by the uniform motion of the first movable part to connect the electric contact points only in the interval between the movement of the last two movable parts. In the embodiment of the invention, a cam-wheel is employed which may be rotated by a clock of any suitable construction and may be carried on the second-hand shaft, revolving once in a minute. This cam-wheel has one or more projections similar to the teeth of a ratchet-wheel. These are four in number and are spaced to correspond to intervals of fifteen seconds apart. Two pivoted lever arms close the circuit by connecting the contact points when in the revolution of the cam-wheel the end of one lever arm drops from one of the projections and before the end of the other (which is slightly longer than the first) has fallen from the projection. As soon as the first lever arm has dropped from the projection, the contact points are again separated, so that the circuit is closed only during the interval between the falling of one lever arm and the falling of the other from the same projection, which occurs once every fifteen seconds, the circuit being broken at all other times. To make the motion of these lever arms positive and quicker or to adapt them to other positions, they may be spring-

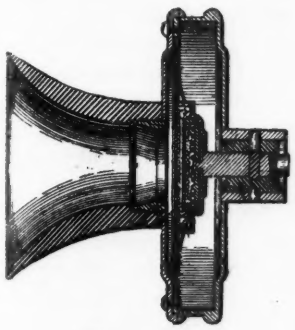


CIRCUIT-CLOSER AND BREAKER.

pressed instead of falling by the force of gravity. In order to regulate the length of the contact of the points, one of the lever arms is pivoted on a lever, fulcrumed on the frame of the mechanism, so that by slightly turning the lever the length of time between the falling of one lever arm and the falling of the other from one of the projections of the cam-wheel may be increased or diminished.

An improved transmitter in which a wide variation of pressure among the carbon granules is obtained, and in which the carbon granules are maintained in a sensitive and separated condition, has been invented by Ernest E. Yaxley, of Chicago, Ill., who has assigned the patent obtained thereon to American Electric Telephone Company, of the same place. The invention comprises a transmitter of substantially the usual form in which granules of the carbon are firmly attached to the inner surface of an electrode, preferably the diaphragm. The back electrode is provided with concentric rings into which the carbon grains wedge to make good contact therewith. The adjusting screw in the back hub is locked in place and in addition is so formed that it is impossible to grasp it with pliers with sufficient force to break the locking means or move it. In the embodiment of

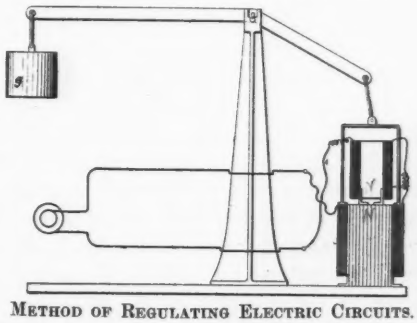
the invention the transmitter comprises a mouthpiece, secured to the front casing, a perforated web being held between them and the front casing, and the front casing being secured to the rear or back casing by screws threaded into a flange thereon. A hub or sleeve is fixed centrally to the back face of the case, by which it is secured to the transmitter arms and forms one terminal of the circuit through the transmitter head. The diaphragm fits snugly within the annular flange, a ring



TRANSMITTER.

or washer of paper or other suitable material being placed at the edge of the diaphragm between it and the adjacent portion of the front casing. Springs carried by posts secured to the underside of the back case bear with their curved double ends upon the edge of the diaphragm to hold it snugly against the ring or washer and to complete the electric circuit therethrough. A cup-shaped back electrode, having preferably concentric grooves, is supported in the rear of the diaphragm in a supporting disc suitably spun or hollowed out to seat the electrode therein and is firmly secured to an adjusting screw which is adjustably held in an insulating sleeve secured in the hub by a pin. The forward end of this screw is reduced or shouldered and passes through a small hole in the stationary electrode and is spun or riveted over to secure the two together. The edge of the plate or disc which extends outwardly forms an annular flange about the electrode on which is carried a ring or strip of felt, plush or other suitable material, and which bears lightly against the inner face of the diaphragm. The edge of the electrode is grooved or shouldered to provide a seat for the edge of a perforated plate or disc, the perforations being large enough for the carbon granules to pass therethrough. The space between the inner face of the diaphragm and the front or grooved face of the stationary electrode and within the ring is filled with granular carbon, which is thus on both sides of the perforated plate. To the inner surface of the diaphragm and within the limits of the ring is secured a layer of carbon granules, preferably by means of a cement of high conductivity so as not to increase the resistance to the passage of the electric current. By this arrangement the variable resistance surfaces or variable pressure surfaces or contact is confined to the carbon itself, as there is no change of intimacy of contact between the carbon and the metallic diaphragm or the electrode so coated, but only among the granules themselves, and in the case of the rear or stationary electrode the action is similar, for the granules wedge into the rectangular concentric grooves and are held thereby. The perforated diaphragm serves to not only increase the action surface of the stationary electrode, but to keep the carbon loose and in a sensitive state. Various changes and modifications may be made in this invention, if desired.

Improvements in methods of regulating electric circuits have been invented by Mr. Malcolm H. Baker, of East Liberty, Pa., who has assigned the patent obtained on the improvements to the Westinghouse Electric and Manufacturing Company. In former patents obtained by Mr. Baker he has shown and described a variety of devices whereby a mechanical force is opposed to the pull of a reactance coil, the force and magnetic pull being so correlated that the choking effect of the coil varies automatically to compensate for changes in the resistance of the circuit. He has shown a method whereby the results are accomplished through the medium of a counterweight acting against the moving part of a reactance device, the moving part and the counterweight being attached to opposite ends of a pivoted lever having a critical angle whereby the varying effects of the weight and the magnetic pull of the coil cause varying choking effects which are adapted to maintain the current in the circuit constant. It is arranged in series with the translating devices in the circuit which it is intended to control and operate through a certain range of action to maintain the current constant. In passing from the position of no load to the position of full load, Mr. Baker has devised several methods of automatically securing the necessary increase in compensating value, such methods being mainly mechanical in their nature. The present invention aims to accomplish the same results by means that are mainly electrical, while at the same time the action is such as to gradually remove any resistance of the compensating coil from the circuit in passing from no load to full load. The means by which this is accomplished comprises an auxiliary coil electrically opposing the original regulator coil, the auxiliary coil being fixed and the regulator coil being adapted to surround the auxiliary coil on a fully loaded circuit. The auxiliary coil is arranged in line with the stationary core of the reactance device or in line with a portion of the core, so that as the moving coil begins to separate itself from the core when the resistance of the circuit is increased by the switching in of a translating device, it also begins to encircle more and more the auxiliary coil which is electrically opposed to it. The two coils are arranged in series with each other and with the translating devices in the electric circuit. When the two coils are apart from each other under a condition of no load in the circuit, the resistance of the two coils is included in the circuit as an element of the total resistance. When, however, the coils begin to approach and the moving coil begins to encircle the stationary coil, the differential relations of the coils are varied until at the position of full load the opposing inductions of the coils substantially cancel each other. During this movement, the counteraction exercised upon the moving coil is not simply the counteraction of the weight opposed to the coil, but it includes also the repulsion effect of one coil upon the other. In carrying out the present invention, an electric circuit is employed including translating devices in the form of arc lamps in series with each other. In the same circuit are a regulator coil and an auxiliary coil, the former being suspended, so as to surround the latter and also to surround a magnetic core constructed of laminated iron. The coils are in series with each other and are wound so as to be electrically opposed to each other. The coil is suspended upon a frame which is itself swiveled or pivoted to one end of a



METHOD OF REGULATING ELECTRIC CIRCUITS.

lever, having a weight attached to its remote end. The lever is pivoted at the top of a standard which is supported like the core upon a suitable base. It will be observed that the lever extends in different directions on opposite sides of its pivot —that is to say, it is bent out of a straight line. The lever is provided with a "critical angle," whereby the effect of the counterbalance between the weight and the moving will be such as to maintain the current in the circuit practically constant. The auxiliary coil may be supported in a fixed position by any suitable means.

Reviews of Current Engineering and Scientific Literature.

The Employment of Water Power to Provide Electrical Energy for Use on Farms.

The French minister of agriculture has issued recently a circular relative to the employment of water power for the purpose of securing electric energy to be used in farming. There exist in France many small water powers undeveloped, or which have been developed and abandoned because the small industries formerly operated by hydraulic power have been unable to compete with a large modern factory. In many cases the dam still exists in fair condition, and this circular discusses the advisability of utilizing this to supply electrical energy for power and lighting purposes on farms in the neighboring districts. In many of the cases where a dam does not already exist, it would seem advisable to develop the power for this use. Even in the low country, where high falls do not exist, there is still considerable power going to waste on rivers which are not navigable or which are no longer used for this purpose. In such cases a dam could be erected and power developed without interfering with other industries. The commissioners suggest that where one individual is not able to undertake the work alone, a company be formed; and consider the advisability of having the French Government assist in this work.—*Translated and abstracted from the Revue Pratique de l'Électricité (Paris), January* 20.

The Great Northern & City Railway.

This railway runs on what is practically a straight line from Finsbury Park to Moorgate street, and an extension has just been begun to Lothbury. When the line was first projected, it was intended to run the rolling stock to the Great Northern tracks at Drayton Park, where it now emerges from the tunnels, but this was found inexpedient and almost impossible, owing to the capacity of the Finsbury Park station being taxed already to its utmost. It was therefore decided to carry the new line underground all the way to Finsbury Park. This has been done, but the work was difficult, as it had to be carried out under the main line tracks without interfering with traffic. The result is that heavy Great Northern express trains, traveling at high speeds, pass over subways, offices and elevators, within two or three feet of the heads of the passengers. The excavation work was hazardous, owing to the nature of the material which had been used for the original permanent way. The variable headway was too small to allow of the use of electric elevators, and hydraulic elevators were adopted, the necessary water for their operation being pumped electrically. The site secured for the power-house represented some engineering difficulties, as it was of an awkward shape. This station contains four 1,250-horse-power cross-compound Musgrave engines, running at 100 revolutions per minute. The generator armature is mounted upon the engine shaft. The station has a complete coal-handling equipment, and is lighted by incandescent lamps, in some places five 108-volt lamps being connected in series. At other points three 185-volt lamps in series are used, this arrangement allowing three lamps instead of five to be used. The conductor rails are channel bars, there being one for the outgoing and one for the return current. The cars are equipped with the multiple unit control system, the contactors being placed in a small compartment opposite the motorman's cab. This arrangement was found necessary, as the position of the conductor rails made it impossible to place the contactors under the cars.—*Abstracted from the Electrician (London), January* 29.

The Radiation from an Electron Describing a Circular Orbit.

This communication from Mr. Oliver Heaviside gives the complete formula for the radiation from an electron. This is derived from the general formula previously given by the author. He then discusses the supposed nature of the X-rays. Rœntgen suggested a longitudinal ether disturbance. This has not found favor, because it requires a new theory of electricity. Schuster suggested very rapid vibrations. This is tenable, because in the inside of an atom rudimentary calculations show that vibrations much more frequent than light are easily possible with revolving electrons. Stokes suggested collisional pulses. This is tenable, too, for collisions must produce electromagnetic pulses. The author believes that X-rays are mixed Stokes pulses and Schuster vibrations, the latter arising from the atoms of the body struck. A pulse differs from a continued vibration, but may be analyzed into the sum of various sorts of continued vibrations. There ought, then, to be a physical difference between the effects of collisional pulses and continued very rapid vibrations. Apart from the emission of electrons and matter, there might be six sorts of radiation, at least, say light vibrations, below light, above light, collisional pulses, cometary pulses, and possibly periodic pulses. There is still a great deal to be found out in the relations of electricity to matter. There is also sometimes a good deal of misconception as to the relations of theory to fact. A pure dynamical theory of electricity, like Maxwell's, can give no information about the connection between electricity and matter. Though theory can not predict facts not contained in it, it is useful as a guide in forming hypotheses to account for the new facts, for it is no use flying in the face of solid theory. Whether the solid theory itself will need to be altered remains yet to be seen. The author sees no sign of it, though he does not believe the etherial theory is complete.—*Abstracted from Nature (London), January* 28.

The Development of the Tangential Water-Wheel.

But a few years ago the impulse water-wheel was a small machine, but its adaptation to driving electric generators has caused a rapid development, so that to-day there are impulse wheels of extraordinary size, as to their dimensions and their output. There is a wheel twenty-two feet in diameter driving an air compressor at the Alaska Gold Mining Company's plant, and within a few months a wheel is to be started which from a single jet of water will develop 7,500 horsepower. The type of construction adopted for these enormous units is described critically by Mr. H. Homberger. Whereas as late as 1895 a head of 775 feet was considered excessive, with a peripheral speed of 6,210 feet per minute, a year ago a plant was started in California where four 750-kilowatt generators are directly connected to tangential wheels running under a head of over 1,900 feet, with a peripheral velocity of 9,700 feet per minute. To increase the power of the tangential wheel operating under a fixed head, the simplest way is to increase the size of the jet of water. Until recently designers were afraid to go beyond a diameter of about four inches. When this was reached they adopted the expedient of adding additional nozzles. This practice

is objectionable, as the two nozzles and the additional curvature necessary make this efficiency for one larger nozzle. Lately single-jet wheels have been adopted, with jets as large as seven and one-quarter inches in diameter. If a smaller size of jet is desirable, it is better practice to adopt two jets driving two independent wheels upon the same shaft. The author criticises the use of the receiver at the end of a pipe line, where the pipe is expanded before reaching the nozzles. This receiver is more expensive than the ordinary pipe, as it is larger and must be of heavier material, and as it also decreases the rate of the flow of water. As a rule, the larger the power plant the higher the velocity in supply pipes. Methods of governing consist of deflecting nozzles and needle valves. The needle valve allows the diameter of the jet of water to be regulated, maintaining the cylindrical orifice and the solid jet. It has been found highly efficient, and when used in connection with a deflecting nozzle saves water and gives good regulation.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), January.*

The Single-Phase Series Motor in Its Relation to Existing Railway System.

In the opinion of Mr. C. F. Scott, the use of the single-phase series motor will eliminate the weakest element in our present traction system, that is, the rotary converter substation. The single-phase system has in it the elements for the development and extension of railway work which may far surpass the impetus given by the rotary converter. It should be noted that the new apparatus is not revolutionary, as the best elements of the old system may be retained, and the new motors may frequently be adapted to old systems. The important elements in the present system which require attention in connection with the single-phase motor are the ability of the motor to operate normally on twenty-five cycles, and temporarily on 500 volts, direct current. It has been found that large as well as small motors may be operated on twenty-five cycles. The frequency first adopted was sixteen and two-third cycles, and experience gained with the first motors has led to the successful design of the twenty-five-cycle motor which makes it possible to retain the present alternators. In fact, this machine may be used by supplying alternating current to the cars equipped with the new motor, and supplying direct current through the rotary converters to the old cars. The several circuits of a polyphase alternator may supply current to different sections of a system, each of which operates single-phase motors. As these motors will operate on 500 volts, direct current, the new equipment may be selected for extensions to present systems, and single-phase current supplied from the station generator. The new equipment will be able to operate over the old lines on direct current when necessary. The single-phase series motors are normally wound for 250 volts, and are suitable for operating two in series on a 500-volt direct-current circuit. Under this condition it will be necessary either to employ a rheostatic form of control, or to place four motors on each car, in order to secure series parallel control. If the car is arranged to operate either upon alternating or direct current, this will generally prevent the use of variable voltage control, on account of weight, cost and complication of the double system. This will not be serious if there are but few stops on the alternating-current section. A study of the savings to be secured by the new system, in eliminating rotary converters, reducing the cost of feeder circuits, and the gain in efficiency, presents sufficient reasons why those who are about to purchase motors for their existing systems should give careful consideration to the desirability of purchasing the alternating-current motor for use on the existing direct-current circuits, as their installation provides the way for a ready change of system in the future.—*Abstracted from the Electric Club Journal (Pittsburg), February.*

The Jungner Alkaline Cell.

In this excellent series of battery notes, Mr. H. L. Joly gives some particulars of the Jungner cell. Jungner's first attempts were directed toward the zinc-potash-nickel modification of the Lalande-Chaperon cell. This was rendered useless by local action in the zinc electrode. The inventor then tried iron mixed with copper oxide for the negative electrode. The positive was either nickel, silver, copper or manganese, caustic potash being always the electrolyte. Cadmium was tried, without any success. In 1896 Joly patented a design of electrode in which the active material is enclosed in a metallic pocket, perforated with numerous holes. The nickel cell was patented in 1899, stress being laid upon the stability of the electrolyte. A cadmium-silver cell, constructed in 1899, met with some success. Two automobile runs of some ninety-three miles were made. The cells, however, were unable to repeat this performance, owing to the deposition of silver on the separators, resulting in a short-circuit. The cell was also expensive. The nickel-iron cell is now being manufactured by the Jungner Akkumulatoren Aktiebolaget. In the construction of the Jungner plates, sheet steel two millimetres thick, nickel-plated and perforated, with the burrs retained, is folded on itself so as to form pockets. The sheet is left solid where folded. Several such pockets are placed side by side and clipped top and bottom by nickeled steel bands, which may be soldered. The cell, as at present constructed, contains five positive nickel plates and four negative iron plates. Its dimensions are 300 by 84 by 74 millimetres (12 by 3.4 by 3 inches), and its total weight is 3.1 grammes (6.8 pounds). The discharge at sixty-five amperes gives a capacity of 130 ampere-hours, with an average voltage of 1.16. Jungner has succeeded in oxidizing the metals by the Plante process, in a solution of potash, so that this mode of manufacture will prove cheaper than the purely chemical method. The cell tested by M. U. Schoop contained five positives and four negatives. The weight of the plates being two and one-half pounds, and that of the electrolyte being 1.10 pounds, gave, at a twenty-ampere rate of discharge, thirty ampere-hours or 30.9 watt-hours. At a ten-ampere rate the output was 39.5 ampere-hours, corresponding to 44.-24 watt-hours. At a one-ampere rate the capacity was forty-eight ampere-hours and 57.6 watt-hours. Schoop and Joly have succeeded in making a gelatinous alkaline electrolyte. The nickel electrode is thought to be more expensive than the positive of a lead cell, but the iron plate should be cheaper than the lead negative. —*Abstracted from the Electrochemist and Metallurgist (London), January.*

Atmospheric Electricity.

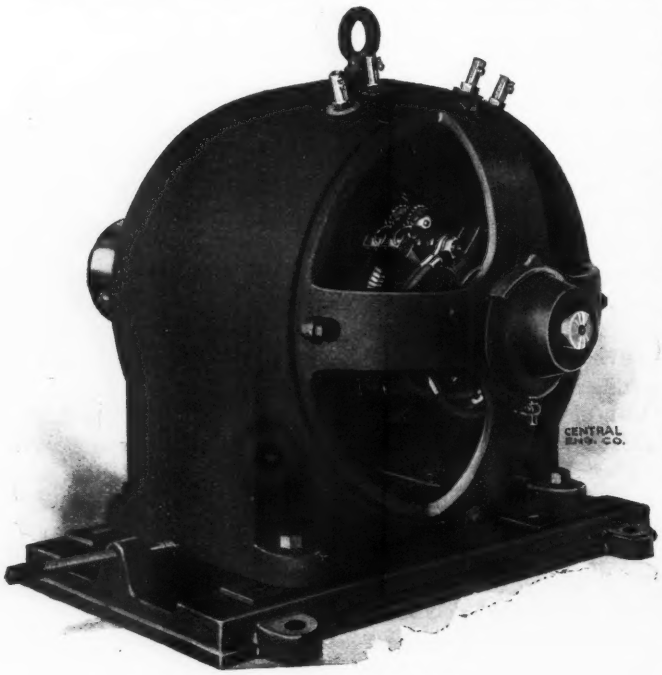
In a communication to *Nature*, Sir Oliver Lodge comments upon the suggestion made by Mr. George Simpson, who pointed out that the sun's α rays would be stopped in the upper atmosphere, whereas the β rays would penetrate much further. It should also be noticed that an energetic separation of these oppositely charged rays would be effected by the earth's magnetic field, the negative being conveyed toward the poles, and the positive remaining near the tropics, along with maximum sunshine. Consequently, quadrantal earth currents would be generated, and likewise a Leyden jar action would be set up in a tropical region of the lower atmosphere, sufficient to account for prevalent tropical thunderstorms. Some magnetic perturbations could also be accounted for.

INDUSTRIAL SECTION.

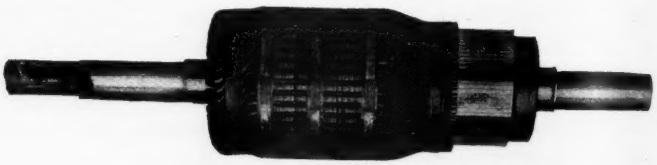
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

"Ideal" Electrical Machinery.

The Ideal Electric and Manufacturing Company, of Mansfield, Ohio, has recently placed on the market a complete line of "Ideal" electrical machinery embracing a line of elevator and hoist motors and controllers, a line of universal motors, which we illustrate with this article, and a complete line of belted and engine-type dynamos and generators in sizes up to 150 horse-power.



OPEN TYPE "IDEAL" MOTOR.



ARMATURE OF "IDEAL" MOTOR.

"IDEAL" ELEVATOR MOTOR.

This company, while apparently new in the field, is backed by men of long years of experience in the design and manufacture of electrical machinery. In its shops at Mansfield it is using individual motor drive applied to modern machine tool equipment, and already the demand for its machines has forced and made necessary increased facilities, and a large new brick building with three floors is under way. This will be ready for occupancy early in the spring. It is the intention of the company to work into larger units as soon as the proper facilities can be provided.

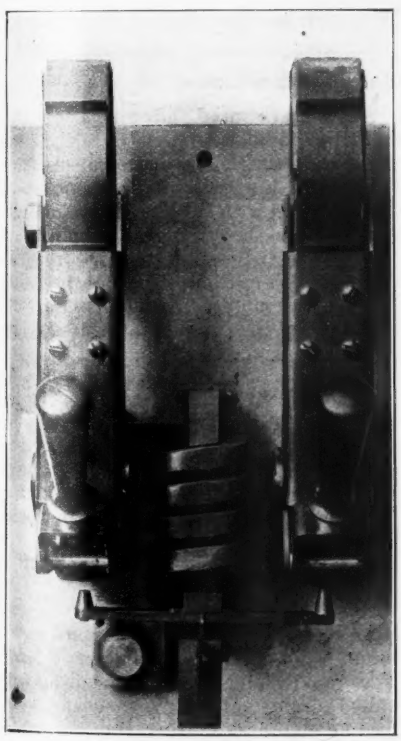
The line of motors illustrated herewith is known as its type R and ranges in capacity from two to thirty-five horse-power. These machines are made in three styles, open, semi-enclosed and enclosed, and can be used for belting, coupling or gearing to the driven machine or shaft and mounted on the wall, floor or ceiling; the mounting can also be changed at the convenience of the user. The design is one that will appeal largely to power users as a machine for general service where a reliable, strong, efficient and durable machine is required. The armature core discs are made of very thin gauge of the very best quality of armature sheets, reannealed after being punched and coated with an insulating compound. They are built up directly on the shaft and provided with ventilating openings parallel to the shaft through which air can pass to the ventilating ducts between the discs and outer ribbed flange, providing thorough ventilation through the entire core and windings. The winding consists of form-wound coils, the smaller armatures being wound with round wire and the larger ones with flat copper strip; they are independently and carefully insulated, dipped in a special insulating compound and thoroughly baked before being put in place on the armature core. Surface bands are used to retain the coils in the slots. The commutators are made from rolled copper bars which are insulated from each other with the best grade of amber mica segments. The segments are of unusual length and depth, allowing an ample margin for wear and ensuring cool and sparkless commutation. The flanges are of cast iron of ample proportion and are insulated from the segments with solid V rings. The commutators are easily removed from the armature shaft. Exceptional care has been used in the design of the mechanical features, as rigid construction is an important factor in a satisfactory performance of this part of the machine. The brush-holders are clamped on the stems close up to the point of brush contact, the brushes being of the best grade of composition graphite and carbon and are fed toward the commutator through a wire trough in the face of the holder. The brushes are held firmly against the face-plate by means of a flat phosphor-bronze spring, brush tension being provided by means of a finger actuated by an adjustable spring. The holder is very simple in design, aside from being reliable in its operation. The brushes operate without vibration, the machines are practically noiseless. The brush-holder stems to which the holders are fastened are carefully insulated from the rocker arm and are secured there in position. The brushes can be readily and independently adjusted and any brush can be quickly removed while the motor is in operation. The brush contact area is in all cases ample for the current to the armature, the current density being very low and at the same time consistent with economical design. After the brushes are properly set no shifting is required and the motor operates without noise and sparks. This line of machines is designed to operate at their full rated capacities without the temperature of the armature or field windings rising more than thirty degrees centigrade and to operate at an overload of twenty-five per cent for a period of two hours and fifty per cent overload for two to three minutes without injurious heating or sparking.

A New Carbon Break Circuit-Breaker.

Since the introduction of circuit-breakers for the purpose of automatically interrupting currents at any predetermined point, manufacturers of electrical apparatus have been constantly engaged in an effort to produce appliances which will break abnormal currents with the greatest degree of regularity of action, and the least damage to the breaking device.

Various means have been employed for minimizing the effect of the final arc since the introduction by the Westinghouse Electric and Manufacturing Company of the first circuit-breaker in which the current was shunted from the main contacts to renewable carbon arcing tips and there broken without injury to the current-carrying portions of the appliance.

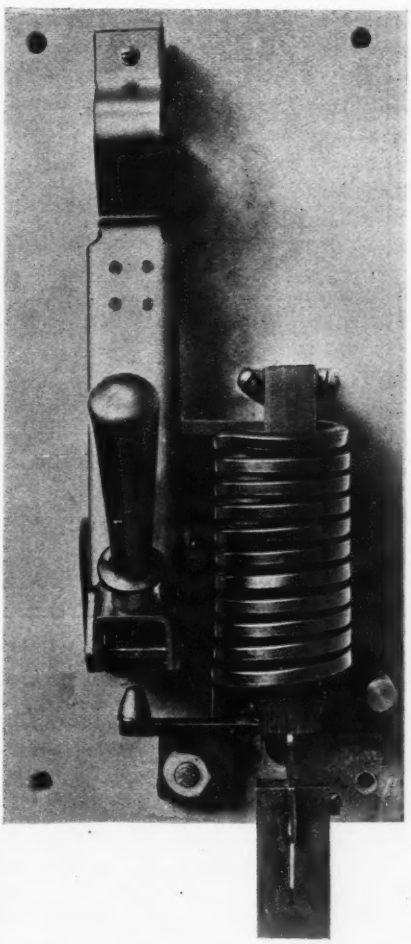
The original circuit-breaker of this type, now known as the Westinghouse type A, has two breaking points. Soon after its introduction the Westinghouse company evolved and placed upon the market the single break, or brush type, of circuit-breaker as exemplified by its



DOUBLE-POLE, CARBON BREAK CIRCUIT-BREAKER.

present types B and C, in both of which carbon-arcing tips are used. This construction, also, has come into general use, and in various forms is found in the devices offered by the different manufacturers.

The constantly growing demand for a high-grade automatic circuit-breaker to be sold at a popular price led to a still further development of existing types, and as a result the type D circuit-breaker has made its appearance. In this device the current is shunted to carbon-arcing tips and there ruptured as in the original



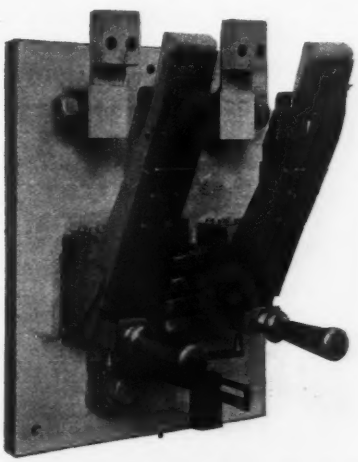
SINGLE-POLE, CARBON BREAK CIRCUIT-BREAKER.

Westinghouse type A, and the single break is used as in the Westinghouse types B and C, the construction being such as to gain the highest degree of efficiency from these and the other features employed.

The type D circuit-breaker is designed for use upon circuits not exceeding 250 volts. Its distinguishing feature is the simplicity of its construction. As will be noted from the illustrations, there is no complicated or hidden mechanism, the entire device being open to inspection. It is small and compact, and thus occupies but little space. There are but few parts, and the most of these are made from punchings, combining strength, lightness and smoothly finished surfaces at a cost which enables the maker to adopt popular prices. There are no springs to get out of order, the only thing of this kind being the flat strip which carries the carbon-arcing tip and which also serves to throw back the movable arm when the breaker is opened. All screws are locked and the adjustments are few and permanent.

The movable contact is a laminated brush made from the best leaf copper and protected by a copper shunt, and so arranged that when the breaker is opened the current is shunted to the carbon above. The arc occurs when the final break is made on the carbons, the construction of the contacts aiding the natural tendency of the arc to rise and preventing it from being communicated to the other live parts. Flexible braided leads carry the current from the movable contact brush to the terminal, thus reducing the number of movable current-carrying contacts to a minimum. The temperature rise of the contacts is, in consequence, never over twenty degrees centigrade with a normal current.

The breaking mechanism is simple. The current passes through a coil through which is thrust one pole of a laminated iron horseshoe electromagnet. The armature is attached to the other pole of the magnet, and is so placed that a current sufficiently strong will draw up the free end of the armature, a movable counterpoise serving to vary the amount of current required. When the armature is drawn up, contact points attached to it strike the toggle joints which hold the breaker closed and the circuit is opened. If desired, it can be opened by hand at



DOUBLE-POLE, CARBON BREAK CIRCUIT-BREAKER.

any time, in the same manner as an ordinary switch. The type D circuit-breaker is made with one, two, three or four poles, thus covering all the requirements for alternating-current and direct-current circuits.

The single-pole breaker is recommended

for use upon motor or lighting circuits when a switch is used in series to complete the circuit after the breaker has been closed. The two-pole breaker is used to interrupt the current simultaneously in both wires of a two-wire circuit. The two poles are closed independently. A switch to complete the circuit is not necessary, as the tripping mechanism is so designed that a short-circuit or an overload will cause the first pole closed to open immediately upon closing the other. This feature combines the functions of two devices at practically the cost of one with added convenience and saving of space.

The three-pole circuit-breaker for use upon a three-wire direct-current or three-phase alternating-current circuit, and the four-pole circuit-breaker for two-phase alternating-current circuit are both so arranged that the poles are closed at the same time by the same handle and tripped simultaneously, either by hand or by tripping coils.

As regularly made, the type D circuit-breaker has front connections as shown, but when desired for switchboard mounting, a threaded copper stud for rear connections is substituted. It is neatly finished in black oxide and presents an attractive appearance.

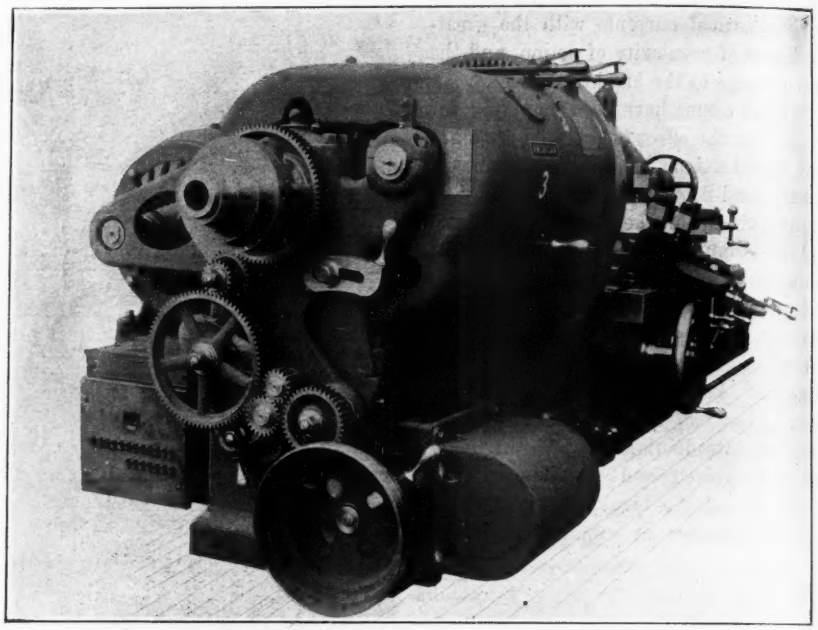
A Thirty-six-Inch Lathe Driven through an All-Geared Head.

Machine-tool builders are vying with each other in the production of motor-driven apparatus and the ingenuity of the engineer is given full scope in the planning of ideas for better and better equipment. Starting with tools of modest sizes the efficacy of the motor drive has been recognized so quickly, that to-day it is being called upon for the heaviest service.

The accompanying illustrations present a regular thirty-six-inch, heavy pattern, triple-geared lathe, motor driven through an all-geared head, just built by the American Tool Works Company, of Cincinnati, Ohio. This method of drive is the one it has adopted for all of its tools driven by variable speed motors. The drive is a very flexible one, since it is equally efficient with any type of variable speed motor. It supplements the speed variations obtainable through the motor by four distinct fundamental geared speeds, arranged in geometrical progression, and the gaps between these speeds can be filled in readily by taking advantage of the variation through the motor. The increments through this drive vary slightly, ten per cent variation being easily obtained.

Through the triple gearing on this particular lathe, the four-speed device acts independently on the spindle direct or on the spindle through face-plate, giving a range of eight fundamental geared speeds.

This drive represents the highest perfection in gear drives, as it requires fewer elements in its construction than any other similar device attaining the same end. This allows any details entering into the construction to be made of strong proportions, and the mechanism and means of operating it are naturally extremely simple. The four speeds are obtained through six gears only, arranged in series of three on two parallel shafts. A simple clutch and lever mechanism, conveniently located, permits of engaging the various trains of gears selectively.

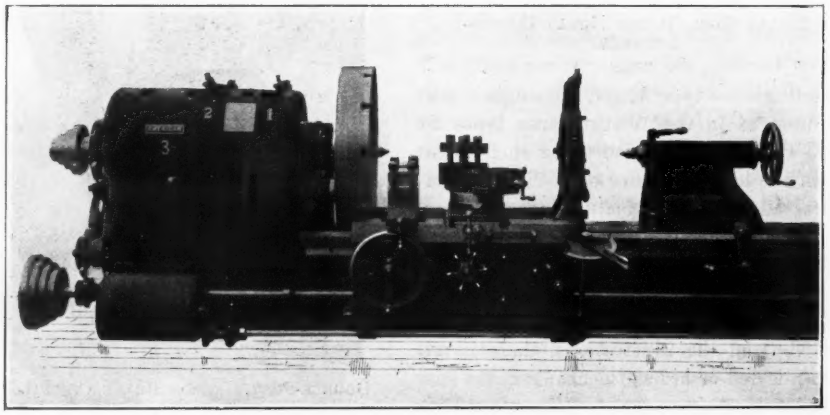


MOTOR AND DRIVING GEARS, THIRTY-SIX-INCH LATHE.

Another essential advantage of this drive lies in the fact that since the total variation through the motor ranges from 2 to 3½ to 1, smaller motors can be used in connection with this drive than in older types, where the back gear supplied but one change in gearing, and the remainder of the variations came of necessity through the motor, in which case a total variation of seven to ten to 1 was required.

The motor used on this lathe shown in nine horse-power with 100 per cent speed variation through field, set on a substantial stand back of the head, and is connected to first work shaft through silent chain. The controlling mechanism for starting, stopping or reversing, also the means for ranging the speeds of the motor, is located conveniently at the right end of carriage.

Aside from the all gear headstock, this lathe embodies all the features of merit found on the regular "American" lathe. The rapid-change gear mechanism provides a range of thirty-six changes for feeding and screw cutting, each change instantly available while the machine is in full operation, and without removal of a single gear. The bed is of its patent drop-V pattern, which gives two inches additional swing and throws additional metal into the bridge of the carriage. The lead screw is on the inside of the bed, thus bringing the pull directly under the cutting tool instead of through the apron, and obviating all torsional tendency by centralizing the strain.



THIRTY-SIX-INCH LATHE, MOTOR DRIVEN.

Increase in Flywheel Accidents.

The reports of flywheel accidents for the past month show an alarming increase not only in numbers but especially in loss of life and amount of property destroyed. The five most disastrous accidents foot up a total of six killed and fifteen injured and property damage valued at $75,000.

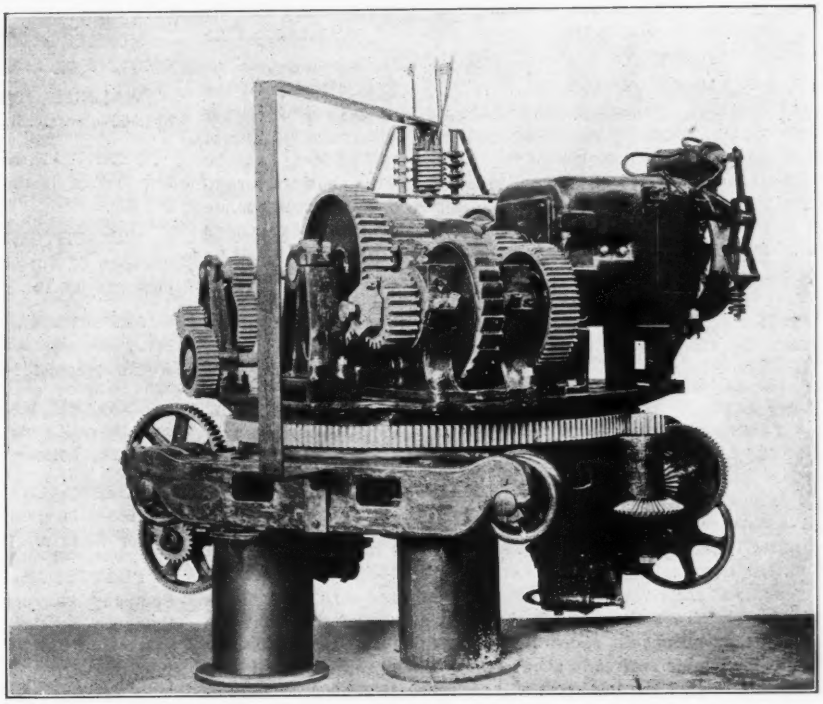
A bursting flywheel not only converts the engine itself into a mass of scrap iron and destroys the building, but invariably does a vast amount of injury to expensive machinery, as in the case of the accident at the city lighting plant, Austin, Tex., where a 3,000-light generator was destroyed, which necessitated cutting out several lighting circuits until repairs could be made and entailing a still greater hardship upon the company by decreased income.

In all the accidents reported the governor belt either slipped or broke, or the sudden relief of the load caused the engine to speed up and the governor failed to respond. These accidents, as well as others, are the more to be regretted because they could all have been prevented.

The Monarch engine-stop and speed limit system made by the Consolidated Engine-Stop Company, of New York, supplements the governor and when that fails from any cause the Monarch speed limit automatically shuts down the engine. The company announces its endorsement and installation by such representative consulting engineers, lighting and railway companies as Stone & Webster; Westinghouse, Church, Kerr & Company, Sanderson & Porter, Boston Elevated Railroad Company, Massachusetts Electric Companies, United Gas Improvement Company, Springfield Street Railway Company, Springfield & Eastern Street Railway Company, Albany & Hudson Railroad Company, Cleveland Electric Railway Company, Pennsylvania Railroad Company, New York Central Railroad Company, Charleston Consolidated Railway and Gas Company, Tacoma Railway and Power Company, Rhode Island Suburban Railway Company, Connecticut Railway and Lighting Company, Rockingham County Light and Power Company, City and Suburban Railway Company, Portland, Ore.; Terre Haute Street Railway Company, Denver Tramway Company, Worcester & Southbridge Street Railway Company, Dayton, Springfield & Urbana Street Railway Company, and others, and such representative manufacturing establishments as United States Steel Corporation, American Brass Company, International Silver Company, United States Leather Company, B. B. & R. Knight, Providence, R. I.; United States Rubber Company, J. L. Mott Iron Works, in fact every industry is represented among the users of the "Monarch" system.

A Ten-Ton Revolving Ingot Charging Crane.

In all large plants which are devoted to the wholesale manufacture of limited lines of work, new forms of special apparatus are continually being brought out with a view to increasing the producing capacity by developing the equipment facilities to the highest possible degree. Especially is this true of the steel industry. One of the latest improvements for use in this field pertains to the ingot handling and is illustrated herewith, being a revolving ingot charging crane, installed in the A. & P. Roberts works of the American Bridge Company, by the Morgan Engineering Company, of Alliance, Ohio. For its operation, which is entirely electrical, there are five Crocker-Wheeler K-type motors, each serving a distinct purpose. One of forty-five horse-power drives the main hoist, one of twelve horse-power provides the trolley travel, and one of thirty horse-power the bridge travel.



A Ten-Ton Revolving Ingot Charging Crane.

The bridge is of the usual type of construction common to traveling cranes, but the trolley, shown by itself in the accompanying illustrations, is a radical departure. The base of the trolley is a circular casting in one piece with and connecting the side frames which form the trolley trucks. On it is supported the mechanism for traveling the trolley and revolving the hoist. The former is driven through three reductions of spur gearing from the motor which is carried on the under side of the base, the opposite end of the motor being provided with a friction band brake controlled by a solenoid. Through two trains of spur and one of bevel gears the motor is connected to a pinion which meshes with a spur-gear band about the base of the turret. This motor, like all the others, also has a solenoid brake. The hoist is supported on steel balls rolling in grooves on the upper and lower members so that it may be easily revolved to any desired position, to allow the tongs, which are suspended from the hoist, to grasp an ingot at whatever angle it may. The main hoist motor is mounted above board in a compact manner and transmits power to the hoist through two reductions of spur gearing. In addition to the solenoid brake it has a mechanical load brake, which automatically prevents the load from descending unless the motor is revolved in the lowering direction. By this arrangement all strain due to load is taken from the motor and the gears between the motor and the mechanical brake, except in the act of hoisting. The pawls working in the ratchet of this brake are held out of contact during hoisting and are therefore noiseless.

The electrical connections to the bridge and the trolley are made in the usual way through shoes sliding on bare copper trolley wires, and the connections to the hoist motor through the slip rings and brushes mounted overhead, as shown.

All the movements of the crane and the manipulation of the trolley hoist are directed through controllers of the Crocker-Wheeler make, contained in the operator's cage, making it equally as manageable with the same amount of attendance as an ordinary traveling crane.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

FORMAL ANNOUNCEMENT OF CHANGE OF NAME—Mr. H. H. Vreeland, president, issued the following on February 9: "To all concerned—By the authority of the Supreme Court of the State of New York, and with the approval of the Board of Railroad Commissioners of the State of New York, the Interurban Street Railway Company has this day changed its corporate name to New York City Railway Company."

INTERRUPTIONS TO CABLE SERVICE—The Commercial Cable Company is in receipt of the following Shanghai advices: "Russian administration notifies private telegrams over the Port Arthur cable can not be accepted. The Western Union's central cable office is advised that telegrams of all kinds for Japan and Corea can now be forwarded by any route except the Great Northern. Senders should be advised that messages are only accepted at their risk. Messages for Japan are no longer restricted to Japanese, English or French. Any language may now be used."

TO ISSUE $6,500,000 MORTGAGE—The board of directors of the United Traction Company, operating the traction system of Albany and Troy, has approved of a financial plan, the main feature of which is the issue of a mortgage for $6,500,000. The issue is to be used for the redemption of outstanding bonds of the subsidiary companies as they mature and to pay for improvements already made and in progress, while $1,339,000 is reserved for future extensions and betterments. Nine hundred thousand dollars in bonds will be offered for sale at this time. The Central Trust Company, of New York, is to be trustee under the mortgage. The plan contemplates, it is said, some extensions or consolidations with other roads in this vicinity, the exact nature of which it is impossible to learn at this time.

CAROLINA POWER PLANT—Headed by Whitney & Stephenson, the Pittsburg syndicate which has been for three years engaged in important development work in North Carolina, is about to undertake the construction of a large water power plant. The horse-power to be developed by the construction of two dams will be 46,000. The plan is made possible by the falls of the Yadkin river, about twenty-five miles from Salisbury, N. C., where a rapid fall of the river is found, the decline being about twenty-five feet to the mile, and at the "narrows" the river is compressed into a gorge with steep banks of solid rock. To make possible the carrying out of the plans the syndicate has purchased about 15,000 acres of land, which it now holds in fee simple. Already about $150,000 has been expended, and it is estimated that the total cost will approach $5,000,000. The company expects to build an industrial town of much importance, all the facilities needed being supplied with free sites for factories.

EXTENSIVE IMPROVEMENTS FOR MILWAUKEE ROAD—Extensive improvements will be made by the Milwaukee Electric Railway and Light Company and the Milwaukee Light, Heat and Traction Company during this year. President John I. Beggs has returned from New York, where he has been attending the meeting of the board of directors, at which the plans for the coming season were considered. The following announcement has been made by Mr. Beggs: "Our board has approved of an expenditure of $2,000,000 this year on the urban and interurban lines here. This money will be expended on the general office, central car house, and terminal station at Third and Sycamore streets; the addition to the Commerce street power-house, the extension of the interurban line from Hale's Corners to Muskego lakes, the building of the line from Wauwatosa to West Allis, the double tracking of our lines in certain places where there is but a single track at present, the placing of fifty new cars on the city lines, and twenty new trailers to be used on the interurban lines. We are going ahead with the northern half of the Commerce street power-house as soon as possible. We put in 10,000 horse-power there last year and shall add 15,000 horse-power during the present season, making a total of 25,000 horse-power. Work on the general office building and central car house will be resumed as soon as the weather will permit. It will require about fifteen months to complete this building, which will be used as the terminal station for all the interurban lines. We shall run all the cars on the Racine, Waukesha, Muskego lakes, and all other interurban lines in there. The Hale's Corners line will be extended from Muskego lakes as soon as the season opens, and work on the line from Wauwatosa to West Allis will be commenced as soon as they get through with the litigation."

ELECTRIC LIGHTING.

CHENANGO FORKS, N. Y.—It has been voted to raise $4,500 to complete the electric light system.

DULUTH, MINN.—The village trustees of Koochiching have decided to install a municipal electric light plant.

ST. PAUL, MINN.—The electric light plant at Fort Snelling has been completed and is now in operation. It cost $75,000.

McGREGOR, IOWA—The electric light plant, which was recently destroyed by fire, with a loss of $11,000, will be rebuilt.

WALNUT, IOWA—The city council has adopted plans for a $14,000 electric light plant, work to begin as soon as possible.

PENN YAN, N. Y.—The question of installing a municipal lighting system is under advisement. The cost is estimated at about $20,000.

FRENCHTOWN, N. J.—A company is being formed for the purpose of furnishing electric lights for streets, residences and business houses.

JEFFERSON, GA.—H. W. Bell and Paul B. Matthews are considering the advisability of establishing an electric light and waterworks system for Jefferson.

SEWARD, NEB.—The new electric light plant being put in by the city will soon be ready for operation. Power will be furnished from the boilers of the water plant.

CORONA, CAL.—The Corona Gas and Electric Company will run a three-mile transmission line to the Auburndale tract, to furnish power there and at intervening points.

PLATTSBURGH, N. Y.—The Plattsburgh Light, Heat and Power Company has contracted with the Delaware & Hudson Railroad Company to light the railroad yards and buildings in this city.

WEBB CITY, MO.—At a meeting of the Webb City council a franchise was granted to W. G. Sergeant to install an electric system. Power for its operation is to be generated on Spring river, near Baxter springs.

LORAIN, OHIO—The Logan Gas Company has signed contracts for the necessary machinery for the new electric plant which the company will install. It is expected that the plant will be in operation in sixty days.

JUNCTION CITY, ORE.—The special city election called for the purpose of voting a thirty-year franchise for an electric lighting system resulted in a vote of seventy-three to five in favor of the proposition. It is expected that the franchise will be granted to the Booth-Kelly company, which purposes to furnish power from mills located at Harrisburg, and these are expected to be in operation before January 1, 1905.

LAS VEGAS, N. M.—It is said that Las Vegas, Albuquerque and Santa Fe will be connected by an electric system which will draw its power from the Pecos falls, twenty miles from this city. The Capital Light and Power Company has sold its interests to J. C. Bonner & Company, of Toledo, and to New Mexican associates of the Ohio men. The local interests have assumed the bonuses of $25,000 each asked from the three cities, and the company now announces that it will establish a plant on the upper Pecos. Bonds to the amount of $300,000 will be issued, and work is to begin in the spring.

ELECTRICAL SECURITIES.

The outbreak of war in the Far East was one of the chief topics of discussion, and the most important factor in shaping events during the past week. The conflagration at Baltimore also had a minor effect upon manipulation, but the market generally withstood what was expected to be a shock considerably better than was anticipated. The steel and iron trade shows considerable improvement, and the extreme weather conditions which have been felt throughout the entire country are holding back construction, so that there is every evidence that as soon as better weather prevails there will be a distinct boom in activity. Contractors, in general, are finding it possible during the hard winter to carry on considerable business, and are quietly making plans for large extensions in the early spring. Although prices show a decline, as compared with a week ago, the sag has been quite regular, and has not been accompanied at any time by anything which savored of a stampede.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 13.

New York:	*Closing.*
Brooklyn Rapid Transit	42⅝
Consolidated Gas	189½
General Electric	165
Kings County Electric	181
Manhattan Elevated	142
Metropolitan Street Railway	117
New York & New Jersey Telephone	145
Westinghouse Manufacturing Company	170

The Kings County Electric Light and Power Company has declared the regular quarterly dividend of 2 per cent.

The statement of the Interborough Rapid Transit Company for the quarter ended December 31, 1903, is as follows: gross, $3,657,709; expenses, $1,396,395, leaving a net income of $2,261,314; other income, $85,599, making the total $2,346,913; charges, $1,596,579, leaving a surplus of $750,334. As compared with the corresponding period in 1902, the following increases are shown: gross earnings increased 13.9 per cent; net earnings increased 21.8 per cent, and surplus after charges increased 65.5 per cent. The company's balance sheet, as of December 31, 1903, shows total assets of $39,109,920, and liabilities of $37,597,319, the surplus amounting to $1,512,601.

Application has been made to the New York stock exchange for the listing of $5,000,000 Brooklyn Rapid Transit first refunding mortgage 4 per cent coupon bonds of 2002.

A special stockholders' meeting of the Metropolitan Street Railway Company will be held at 621 Broadway, New York city, March 16, at 12 noon. The purpose of the meeting is to authorize and approve a lease by the Metropolitan of the railroad routes and other property of the Central Crosstown Railroad Company.

Boston:	*Closing.*
American Telephone and Telegraph	123¼
Edison Electric Illuminating	234
Massachusetts Electric	77
New England Telephone	120
Western Telephone and Telegraph preferred	81

Philadelphia:	*Closing.*
Electric Company of America	7⅞
Electric Storage Battery common	52
Electric Storage Battery preferred	52
Philadelphia Electric	5⅞
Union Traction	47
United Gas Improvement	84½

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	150
Metropolitan Elevated preferred	47½
National Carbon common	24
National Carbon preferred	94
Union Traction common	4½
Union Traction preferred	30

NEW INCORPORATIONS.

MIFFLIN, OHIO—Mifflin & Widowville Telephone Company Increased from $1,000 to $5,000.

KEYSTONE, S. D.—The Minnegahta & Red Cañon Railway Company. $10,000. Incorporators: George A. Clark, Charles A. Clark, M. R. Tailerm, Ela D. Axford and C. I. Patton.

DENVER, COL.—Greeley & Northern Railway and Utility Company. $1,000,000. Directors: George T. Spear, Charles H. Ramsey, Edward T. Decker, George H. Sethman, William Wilson, Greeley.

SPRINGFIELD, ILL.—Alton & Eastern Railway Company. $5,000. Incorporators: Rudolph Wintermann, G. E. Chamberlain, St. Louis; M. T. Whitenenack, J. D. McAdams, Alton; R. A. Bostwick, Granite City.

PERSONAL MENTION.

MR. HALFORD ENSINGER has been appointed local manager of the Bell Telephone Company, Crawfordsville, Ind.

MR. GEORGE A. McKINLOCK, of Chicago, president of the Central Electric Company, was a New York and Boston visitor last week.

LORD RAYLEIGH, the eminent British physicist, has been created a foreign knight of the Prussian Order pour le Mérite for sciences and arts by the German Emperor.

MR. L. E. TRAVER, who has been manager of the Chicago Telephone Company, McHenry, Ill., for the past two years, has been made manager of the exchange at La Grange.

MR. W. W. LYON, representing the Cumberland Telephone and Telegraph Company, Nashville, Tenn., is arranging for the establishment of a telephone exchange at Ashland City, Tenn.

MR. L. G. BOWMAN has left the North Electric Company, Cleveland, Ohio, to accept the position of general manager of the Eastern Telephone Manufacturing Company, West Chester, Pa.

MR. A. A. CAMPBELL, acting division master mechanic of the Kansas City Southern at Shreveport, La., has been appointed master mechanic, with headquarters at the West Shreveport shops.

MR. H. H. SINCLAIR, of Los Angeles, Cal., who is general manager of the Edison Electric Company, of the same place, has left the city for a year's cruise on his yacht, the Lurline. Mr. Sinclair is accompanied by his family.

MR. J. K. STEWART, assistant engineer of the Pennsylvania Railroad at Harrisburg, Pa., has tendered his resignation to enter into partnership with Mr. Andrew Brann, railroad and bridge builder, of Philadelphia, Pa.

MR. D. W. LUM, who for some time past has been engineer of bridges and buildings of the Southern Railway Company, has been appointed chief engineer of maintenance of way and structures, with headquarters at Washington, D. C.

MR. O. A. SANDBARGH, assistant electrical engineer of the Marine Engine and Machine Company, Harrison, N. J., has resigned his position to accept an appointment with the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa.

MR. FREDERICK A. WALDRON has opened an office at Stamford, Ct., as consulting engineer. He will devote his attention to the design, installation, organization and operation of power equipment and distribution, with special reference to the steam turbine.

MR. JOHN H. KELMAN, who for a number of years past was prominently connected with the Stanley Electric Manufacturing Company, Pittsfield, Mass., has tendered his resignation, and it is reported that he will join the electrical force of the Allis-Chalmers Company.

MR. DOUGLASS BURNETT has been elected general manager of the United Electric Light and Power Company, of Baltimore, Md. Mr. Burnett was recently associated with the New York Edison Company, and has had a splendid training both in professional and practical lines.

MR. T. B. REDMOND, heretofore superintendent of the Saginaw Valley Traction Company, Mich., which operates about eighty miles of electric lines in the vicinity of Saginaw and Bay City, has been appointed superintendent and manager of the East Moline & Watertown (Iowa) interurban line.

MR. C. E. BROWN, recently assistant works manager of the Canadian General Electric Works, Peterboro, Ontario, was presented with a handsome dress suit case by the employés on his retiring from the company to accept a position on the government commission appointed to investigate electrical smelting in Europe.

DR. MAX VON RECKLINGHAUSEN lectured on Thursday, January 21, before the Camera Club, London, on "Mercury Vapor Lamps and Their Application to Photography." Dr. von Recklinghausen traced the history of the mercury lamp, discussed its theory and construction, and pointed out its suitability for photographic purposes.

TELEPHONE AND TELEGRAPH.

SPIRIT LAKE, IOWA—The Midland Telephone Company will install an exchange here.

CONCORD, N. C.—A telephone line is being built from Glass to Coddle, in Cabarrus County.

OWEGO, N. Y.—A new telephone line is being put up from Owego to Hiawatha and Broadway.

RAVENSWOOD, W. VA.—A new telephone line is being constructed from this town to Ripley.

TROY, N. Y.—The Hudson River Telephone Company will soon erect a new building in Saratoga.

CEDAR FALLS, IOWA—A franchise has been voted a telephone company projected by R. A. Davison.

THOMASVILLE, GA.—Moultrie is to be connected with Pavo and Boston by long-distance telephone.

OTTAWA, ILL.—The Vermillion County Telephone Company has absorbed the Central Union Company's system in Danville.

EL PASO, TEX.—The Southwestern Telegraph and Telephone Company has begun the work of installing its system in this city.

HAMMONDSPORT, N. Y.—A telephone line connecting Dundee, Rock Stream, Reading Center and Watkins is to be built in the near future.

ELMIRA, N. Y.—It is reported that the Bradford Telephone Company, of Tonawanda, will build a line to Canton and through Williamsport.

ALBANY, N. Y.—The Hudson River Telephone Company states that it will begin the erection of a line from Valatie to Niverville in the spring.

BUFFALO, WYO.—The city council of Buffalo has granted an exclusive forty-year franchise to the Rocky Mountain Bell Telephone Company.

SIOUX CITY, IOWA—An independent telephone company will build a toll line from Odebolt, sixty miles, and from Le Mars, twenty-five miles.

CORUNNA, MICH.—The Farmers' Telephone Company has its line from Nicholson to Bancroft about completed and will probably extend it to Corunna.

WORCESTER, MASS.—Plans are on foot for the burying of a large number of wires by the New England Telephone and Telegraph Company this year.

ROLLAG, MINN.—The Rollag Telephone Company has been organized with a capital of $25,000, to do business in Clay, Wilkin, Becker and Otter Tail counties.

CORFU, N. Y.—The Corfu Home Telephone Company is installing a system which covers the village and will extend about three miles east and west along the main road.

MILWAUKEE, WIS.—The stockholders of the Wausaukee Telephone Company have voted to sell the Marinette County toll lines to the Wisconsin Telephone Company for $6,000.

IRONTON, OHIO—Eastern capitalists have purchased the property of the Lawrence Telephone Company, having exchanges here, at Ashland, Catlettsburg, Russell and Rush, Ky., and minor points.

PALOUSE, WASH.—C. H. Patton and H. K. Moore will build a telephone line from Palouse to Princeton, and will install a 100-drop switchboard here. The farmers on the Eckes road have also formed a company to build a line into Palouse. This will be eight miles long.

MIDDLEBURG, N. Y.—At the annual meeting of the Middleburg Telephone Company, the officers were reelected as follows: president, C. S. Best; vice-president, Daniel D. Frisbie; secretary, Dow Beekman.

SCRANTON, PA.—The Pennsylvania Telephone Company is spending $200,000 improving its service in this city. The company has approximately 4,000 subscribers in the Scranton district, between Archibald and Avoca.

KINGSTON, N. Y.—The Citizens' Standard Telephone Company, of this city, has made connections with the Independent Union Telephone Company and the West Shore Telephone Company, of Catskill, thereby giving service to Athens and Smith's Landing.

BALTIMORE, MD.—The city council of Charlestown, W. Va., has agreed to grant a franchise to the Southern Bell Telephone Company, which will build a line from Staunton, Va., to take in all the towns in the Valley of Virginia between that place and Harper's Ferry.

FLORENCE, S. C.—The Southern Bell Telephone line has been completed to Marion and Dillon, and will be pushed on from Marion to Whiteville, where it will connect with the Inter-State line that connects with Wilmington, the Bell company having acquired the Inter-State line.

WASHINGTON, PA.—A deal has been closed by which J. T. Bebout, of Claysville, becomes the owner of all the property of the Federal Telephone Company in Buffalo, Blaine and Donegal townships, and in the borough of Claysville, except the toll line to Washington. The new owner purposes to establish exchanges at Claysville, Taylorstown and West Alexander.

SKOWHEGAN, ME.—The Somerset Farmers' Cooperative Telephone Company has organized with these officers: president, Clarence Rogers; treasurer, C. L. Holbrook. Contracts will be made at once for building a line from Corson's Corner, in Stark, by way of Frederick's Corner to Norridgewock Village, and from there to the Starks town line, a distance of some fifteen miles.

STERLING, ILL.—The Tampico Farmers' Mutual Telephone Company has been incorporated with a capital of $4,900. The incorporators are W. A. Maloney, A. C. Hunter and E. B. Cummings. This corporation takes in a number of the farmers' lines doing business in the southern part of the county and the northern part of Bureau and Henry counties, four companies being merged into one.

CLARKSVILLE, TENN.—The stockholders of the Home Telephone Company, with headquarters in this city, have elected the following directors: H. C. Merritt, B. F. Gill, J. H. Smith, Dancy Fort, C. P. Warfield, of Clarksville; W. T. Thomas, of Cumberland City, Tenn.; W. R. Boone, of Erin, Tenn.; W. J. Nagel and R. B. Crane, of Toledo. The directors elected the following officers: H. C. Merritt, president; B. F. Gill, vice-president; Dancy Fort, secretary-treasurer. The company now has exchanges in Clarksville, at Cumberland City and Erin, Tenn., and at Guthrie, Ky., and in the spring work will be commenced on a line from Guthrie to Bowling Green, Ky.

PITTSBURG, PA.—It is stated that the Pittsburg & Allegheny Telephone Company will adopt the automatic system in its one-exchange towns. The company has just completed arrangements for adding about 5,000 subscribers to its list by connecting with the National Telephone Company, of Wheeling. The system connects with the river towns in both Ohio and West Virginia, as well as Washington, Pa. The first connection with this company will be made *via* Uniontown, where the Tri-State Telephone Company has just been connected up with the National. A couple of months will be needed for this work. The Tri-State Company, also to be a Pittsburg & Allegheny connection, extends through the coal and lumber regions of West Virginia. The Pittsburg & Allegheny's new line to Johnstown will be ready in March.

WILMINGTON, DEL.—At the annual meeting of the stockholders of the Diamond State Telephone Company it was announced that during the past year the company had acquired several smaller telephone systems, notably among which are two lines in the Virginia counties of Accomac and Northampton. The acquisition of these smaller companies places the whole Peninsula under one telephone system, with Dover as the main office, and Salisbury, Md., as another principal point. The stockholders elected the following directors: Harry A. Richardson, Dr. E. S. Anderson, J. D. Fooks, Richard R. Kenney, George M. Jones, A. B. Richardson and Stephen Slaughter. These officers were elected by the directors: president, Harry A. Richardson; vice-president, Dr. E. S. Anderson; secretary and treasurer, duPont Walker; general counsel, R. R. Kenney; general manager, W. H. Baker.

AUTOMOBILE NOTES.

THE GERMAN AUTOMOBILE CLUB, Berlin, Germany, announces that at the instigation of its government, it was decided that every car which goes to the Gordon Bennett Race, domestic or foreign, must carry a sign with the inscription "G. B." and a running number on it. No car which is not provided with one of the signs will be allowed to cross the German boundaries. The Automobile Club of America announces that in accordance with the above conditions, it will be to the advantage of every member of the club who expects to enter Germany at the time of the Gordon Bennett Race (June 17) to notify the club secretary at once, so that signs and numbers may be secured in advance.

A VERY SUCCESSFUL SHOW HELD AT CHICAGO, ILL.—The Chicago automobile show opened on Saturday, February 6, at the Coliseum. There were some 155 exhibitors, and the general impression was that, although there had been more at the recent exhibition held in New York city, at Madison Square Garden, a more valuable collection of material was shown at Chicago. The opening attendance was extremely large, and there was considerable enthusiasm in the examination of the exhibits. Among those which exhibited were noticed the Autocar Company, Ardmore, Pa.; Crest Manufacturing Company, Cambridge, Mass.; the Columbus Motor Vehicle Company, Columbus, Ohio; the Electric Vehicle Company, Hartford, Ct.; the Ford Motor Company, Detroit, Mich.; the Holley Motor Company, Bradford, Pa.; Thomas F. Jeffery & Company, Kenosha, Wis.; Knox Automobile Company, Springfield, Mass.; Northern Manufacturing Company, Detroit, Mich.; National Motor Vehicle Company, Indianapolis, Ind.; George N. Pierce Company, Buffalo, N. Y.; Pope Motor Car Company, New York, N. Y.; Studebaker Brothers Manufacturing Company, South Bend, Ind.; White Sewing Machine Company, Cleveland, Ohio; American Coil Company, West Somerville, Mass.; Detroit Motor Works, Detroit, Mich.; Dayton Electrical Manufacturing Company, Dayton, Ohio; Electric Contract Company, New York, N. Y.; National Carbon Company, Cleveland, Ohio; Shelby Steel Tube Company, Pittsburg, Pa.; Veeder Manufacturing Company, Hartford, Ct.; Varley Duplex Magnet Company, Providence, R. I.

OBITUARY NOTICES.

MR. WILLIAM E. DOWNS, one of New Haven's oldest and most prominent citizens, died in Florida on February 1. Mr. Downs was eighty years of age, and was graduated from Yale in 1845. He was a director of the Southern New England Telephone Company, and also of the New Haven Water Company.

SENATOR MARCUS A. HANNA, junior senator from Ohio, died at 6.40 o'clock Monday evening, February 15, in his apartments at the Arlington Hotel, Washington, D. C. Mr. Hanna had been ill since early in December. He was born in New Lisbon, Columbiana County, Ohio, September 24, 1837. When he was fifteen years of age his father, who was a Quaker physician, gave up this profession and went into the grocery business in Cleveland, Ohio. In Cleveland he went to the Cleveland High School, and later to Western Reserve College. At twenty years of age he entered the firm of Hanna, Garretson & Company. In 1861, upon the death of his father, he took upon himself the active management of the business. In 1867 Mr. Hanna reorganized the shipping firm of Rhodes, Card & Company into the firm of Rhodes & Company. When Mr. Rhodes, his father-in-law, retired, the firm became M. A. Hanna & Company. This company later became the greatest shipbuilding and owning firm in the Great Lakes, and had probably the greatest share in developing the Lake Superior copper and iron mining possibilities, controlling practically the coal-carrying business of the lakes. Mr. Hanna organized and had a large share in the Cleveland Transportation Company, formed for the construction of iron lake steamers. He organized, several years later, the Pacific Coal and Iron Company, of St. Paul, of which he was elected president. He was also president of the West Republic Mining Company, of Marquette. He organized the Union National Bank, of Cleveland, Ohio, and was its president. He reorganized the Cleveland street railways into the Cleveland City Railway Company, with a capitalization of $8,000,000. He was the owner of the Euclid Avenue Opera House in Cleveland, and during President Cleveland's administration was appointed a director of the Union Pacific Railroad. When Mr. McKinley ran for congress for the first time in 1870, Mr. Hanna took an active and helpful interest in the campaign. In 1884 and 1888 he went to the national conventions of the Republican party as one of Ohio's delegates. He had been a member of the Republican state committee since early in the eighties. Mr. Hanna's management of the McKinley campaigns of 1896 and 1900 has been quoted as one of the most remarkably clean and business-like ever launched in the country.

ELECTRIC RAILWAYS.

VINITA, I. T.—Surveyors are at work locating a line of railway from Siloam Springs, Ark., to Finita and Alva, Okla.

ALLISON, IOWA—A twenty-five-year franchise has been granted to the Marshalltown Electric Street and Interurban Railway Company.

OTTAWA, ILL.—The directors of the Dixon, Rockfalls & Southwestern electric railroad will extend the line from Sterling to Rockford.

CORSICANA, TEX.—The Corsicana Transit Company has increased its capital from $100,000 to $175,000, and will, it is reported, build extensions.

SHARON, PA.—The Ellwood city council has granted a ninety-nine-year franchise to the Ellwood Electric Street Railway Company. The road will be built at once, and will occupy the principal streets of the town.

PORTAGE, WIS.—Eastern capitalists are said to be contemplating the building of an electric line from Portage through Adams County to Grand Rapids, at a cost of $100,000. The road would be seventy miles long, touching at Oxford and Friendship.

CHARLESTON, W. VA.—The property of the Kanawha Valley Traction Company, owned by Russell A. Brown, of Cleveland, Ohio, has been purchased by a syndicate composed of Judge Peter Grosscup, W. O. Johnson and others, of Chicago, and Fred P. Grosscup, of this city.

CARLISLE, PA.—An important merger, whereby the various electric lines in Cumberland County have been consolidated into the recently chartered Valley Traction Company, has been completed, the Cumberland Valley Electric Company, operating lines between Carlisle and Mechanicsburg, *via* Boiling Springs, and the power plant of the United Electric Company, on the banks of the Susquehanna, at Riverton, having been acquired.

NEW ALBANY, IND.—The Louisville & Southern Indiana Traction Company, which operates the street railway systems in New Albany and Jeffersonville and the interurban line between the two cities, and which has secured a lease on the Big Four Bridge for an entrance into Louisville, is practically ready to begin the building of its line into Louisville. With its leased and owned lines, amounting to twenty-three miles, the company will serve a population of over 270,000.

TROY, OHIO—The Pittsfield Street Railway Company has decided to petition for an extension of its lines through New Ashford and Lanesboro, to connect with the line which the Hoosac Valley company is planning from Williamstown to the New Ashford line. This would give a continuous line to Troy and Bennington, Vt. The Berkshire company, of Pittsfield, is planning a line through North Adams from Pittsfield, to connect with the Bennington and Troy lines.

SPOKANE, WASH.—Negotiations are now pending between the Washington Water Power Company, of this city, and parties in Whitman County, for the construction of an electric line between Spokane and Colfax. If the necessary power can be secured, the line will be built very shortly. As proposed, the road will be fifty miles in length, and will open up a rich farming country. A. J. Smith, A. H. Gustin and S. J. Crutcher, of Whitman County, are the promoters of the enterprise.

DANVILLE, ILL.—A. G. Madden, of Kingman, is interested in an electric road to be built from Covington to Rockville, which will be financed by eastern capital. Others associated with him are E. S. Booe, R. A. Booe, S. D. Alexander and Hugh McCrary, all of Kingman. The proposed route is from Covington through Coal Creek, Snoody's Mill, Cates, Kingman, Bloomingdale, Glens, Marshal and then to Rockville. The headquarters and power station will be in Kingman, and it is proposed to build the road this year.

INDUSTRIAL ITEMS.

THE STANDARD VARNISH WORKS will be pleased to send its new catalogue, descriptive of insulating varnishes, to any one interested. The general offices of this company are at 29 Broadway, New York city.

THE SPRAGUE ELECTRIC COMPANY, New York city, in bulletin No. 103 describes its dynamotors and motor-generator sets. These are round-type dynamotors for direct current, and round-type motor-generators for direct current.

THE MICA INSULATOR COMPANY, 218 Water street, New York city, has ready for distribution its 1904 price list. This covers "Micanite," "Empire," "M-I-C" compound, "Linotape" and other insulators for high-grade insulation.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., is distributing two attractive pamphlets descriptive, respectively, of the Buffalo fan system of heating and ventilating, and the Buffalo Forge Company engine. This will be sent to those interested upon request.

THE EMPIRE WIRE COMPANY, 43 Exchange place, New York city, is distributing an accounting room calendar for 1904. On the reverse side of the calendar there is a table compiled by W. H. Wherry, Cleveland, Ohio, showing the average price of copper since 1883, month by month.

THE FALL RIVER AUTOMATIC TELEPHONE COMPANY has paid its fourth quarterly dividend at the rate of five per cent per annum. This company has now 1,160 stations, an increase of about 100 for the quarter. The headquarters of the company is at 161 Summer street, Boston, Mass.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, has just printed a splendid catalogue describing and illustrating the old-established line of Peerless fan motors. Reference is also made to Peerless direct-current power motors and generators, motor-generator sets and Peerless transformers.

THE WHITE SEWING MACHINE COMPANY, Cleveland, Ohio, in the fourth number of the White Bulletin, edited by Ray D. Lillibridge, describes the White car for 1904. This bulletin shows in half-tone illustrations a number of types of this machine, and also gives a detailed description of the mechanism.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, has recently produced a new bulletin, No. B-22. This is a descriptive and illustrated souvenir of the North dividend payers. A number of handsome illustrations show switchboards of different types, and also give a very clear idea of the elements which make up this apparatus.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., was fortunate in having its factory outside of the fire zone which destroyed many of the business buildings of that city last week. This company's works is in complete running order, and is turning out a large number of telephones, district messenger boxes, switchboards, resonators for telegraph operators, etc. All orders will be promptly filled as usual.

FRANKLIN H. KALBFLEISCH COMPANY, 31-35 Burling Slip, New York city, announces that the petition in bankruptcy filed by Franklin H. Kalbfleisch has nothing whatever to do with the credit and financial standing of the Frankin H. Kalbfleisch Company. In this announcement the company publishes a statement by Mr. James B. Bergen, counsel for Mr. Kalbfleisch, detailing the correct standing of the company.

THE COLONIAL FAN AND MOTOR COMPANY, Ravenna, Ohio, has ready for distribution its catalogue for 1904. This illustrates and describes in attractive form the well-known Colonial fans. Space is also given to the line of direct-current power motors, comprising spherical bipolar types from one-fortieth to one-eighth horsepower, and multipolar machines from one-eighth to five horse-power. Motors and motor-generator charging sets are furnished in all sizes of multipolar frames. A copy of this catalogue will be forwarded upon request.

THE HAZARD MANUFACTURING COMPANY, Wilkesbarre, Pa., will be pleased to furnish its catalogue of electrical wires and cables. This catalogue describes in condensed form the electrical conductors and other equipment for street railways, electric light and power circuits, telephone and telegraph systems, which this company manufactures. In addition to the descriptions and illustrations of the company's product, there are a number of valuable tables of weights of copper wire, comparative sizes, resistances, carrying capacities and strengths.

THE OTTO WEISS MACHINE DEPARTMENT, of the Chase Machine Company, Cleveland, Ohio, describes a number of cabling and insulating machines in a series of bulletins which it has issued under a single cover. This includes twisting machines, paper-lapping heads, capstan gears, jute heads, spool stranders, reel stranding machines, spooling machines, cable and armoring machines, taping machines, twenty-four-spool stranding machines, etc. The illustrations are well worked up, and the text is accurate and comprehensive.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has issued a handsome catalogue descriptive of Dinkey ventilated controllers. The controller described in this catalogue is the product of five years of progressive development. The original type was brought out at the Homestead steel works of the Carnegie Steel Company, to meet the special requirements of steel mill service. This catalogue shows several types of this controller, and takes up carefully the details of construction and operating mechanism.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is distributing a number of fliers, descriptive of examples of the electric drive for machine tools, with methods of variable speed control. Flier No. 145 describes a balancing transformer for multiple-voltage system, subdividing the generator voltage and automatically balancing any difference in load between the circuits. This flier also shows a number of typical applications and a diagram of circuits. There are in all sixteen examples, treated in separate fliers, of the application of Crocker-Wheeler motors to the machine-tool drive. These are very interesting object lessons, and should be in the hands of every one who is interested in this development.

THE GEORGE B. BLAKE MANUFACTURING COMPANY, 114 Liberty street, New York city, in bulletin B62 describes power-house auxiliary machinery for vacuum making and boiler feeding. The apparatus described includes rotative dry vacuum pumps, vertical cross-compound simplex boiler feed pumps, admiralty type surface condensers with combined air and circulating pumps, vertical twin air pumps, combined pot-valve outside-packed plunger duplex feed pumps and centrifugal pumps for circulating condenser water. This apparatus has been designed to meet the requirements of steam turbine and reciprocating engine units of 5,000 to 10,000 horse-power capacity, using steam of 200 to 300 pound pressure per square inch.

THE TURBINE ENGINEERING COMPANY has established offices at Chicago, Ill., New York, N. Y., and Troy, N. Y. This company is engineers and contractors for complete water power plants. The hydraulic power department is at West Troy, N. Y. The company is prepared to take complete contracts covering the entire installation of water power plants, acting in the double capacity of engineers and contractors, making a single contract and giving a single guarantee covering efficiency and economy of the entire installation. The officers are A. M. Young, president; H. G. Runkle, vice-president; M. J. Warner, treasurer; F. A. Curtiss, secretary; L. G. Read, general manager; G. Sturgess, manager hydraulic power department. The company is sole agent for the Sturgess water-wheel governors, which will be furnished either alone or combined with water-wheels by the best builders of self-governing units.

THE MICHIGAN CENTRAL RAILROAD is calling attention to the attractions of the St. Louis Exposition in a handsome folder which has just been issued by its passenger department. This folder illustrates and describes in more or less detail a number of the features of the exposition buildings and grounds. A topographical map shows the official ground plan, and there is also a map of the city of St. Louis, showing the street car lines and the location of the fair grounds, and a detail surface map of the northern portion of the United States, traversed by the Michigan Central Railroad. Another handsome bulletin which this company has issued is entitled "California and the Pacific Coast." This gives a number of handsome illustrations of typical scenes along the route, and also includes an elaborate schedule. A number of pages of special information are also included in the pamphlet. Mr. O. W. Ruggles is the general passenger and ticket agent, with headquarters at Chicago, and Mr. William H. Underwood is general eastern passenger agent, at 486 Ellicott square, Buffalo, N. Y.